THE

Practical Teacher

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'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

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Health at School.

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X.—PHYSICAL EXERCISE.

THE narrow view of the function of the schoolmaster is well exemplified in some schools by the entire banishment of physical exercise from the rota of school work. We send our children to school for the purpose of training them for the battle of life, which they will have to encounter when they reach to man's estate. It is by the equal and continuous development of each and every part of the body that this battle will be fought with success, and if one part developes at the expense of another, or by its more rapid development puts a bar to the progress of the others, the subject of it is at disadvantage in his future struggles. Many a Cambridge wrangler and Oxford first-class man has found this out in after life. He is able to solve a problem in differential calculus, to make Latin verses, or to read a passage in any of the dead languages at sight, but he has not cultivated the talent of common sense, or educated his muscles so that they can enable him to leap over some slight impediment in his path. He finds himself outstripped in the daily race by men whom he has been taught to despise, and who, in return, have a very small opinion of him and his mental power. The nerve force of thought in his brain has been developed at the expense of his motor power, and as the room for growth is limited, the latter is dwarfed and imperfect. Life is 'organization in action,' and the various functional activities of the body must be carried out with normal energy and in a harmonious manner, if they are to be correct in their responses to any and every call that may be made upon them. Physical exercise is indispensable, and it is quite impossible for the functions of respiration and circulation to be carried on in a proper manner if the muscular system is not developed, and if the material which is necessary for the formation of the muscle is not used up in its proper order. If the muscles are not used equally with the brain tissue, some used up matter is kept back, and will sooner or later act as an impediment to proper brain work, by getting in the way of the latter when it requires all the room which ought to be at its command. The assimilative and disarranging processes of the body are greatly influenced by the activity or inactivity of the muscular system. Hence it follows that no school is properly constituted which does not provide an exercise ground for its pupils, and make the cultivation of muscular force a part of its daily routine. This is not the place to deal with the general effects of exercise, but it will not be out of order to call to mind the fact that, the natural heat of the body being 98·4, it follows that something must be produced in the blood, which is the *débris* of the continuous fire that is always burning, and by means of which the natural heat of the body is kept up to its proper standard. The principal product in this manufacture is carbonic acid (Co_2). The daily amount expired, as I have already shown, is very considerable; it is produced, in a great measure, *in situ* and must be removed from the body. The larger the quantity remaining in the tissues of the body, the more impure is the blood; and the smaller the quantity remaining behind, the nearer the blood is kept to its normal standard. Now it has been proved that taking the quantity expired during rest in the recumbent position as 1, or unity, there has been expired when a person is sitting, 1·18; standing, 1·33; walking one mile an hour, 1·9; walking two miles per hour, 2·76; walking three miles an hour, 3·2; riding on horseback, 4·; walking at four miles per hour, 4·; running at six miles per hour, 7·. Thus it is seen that the quantity excreted is increased seven times whilst running quickly, as compared with rest in the recumbent position. In connection with this elimination of Co_2, there must be a corresponding increase in the absorption of oxygen, and greater ability to maintain the animal heat at its normal standard, without requiring a warmer atmospheric air to live in. It will be easily understood by this one illustration how it is that exercise in the coldest air is accompanied by increased warmth. The union of the oxygen with the carbon, which is set free by the process of assimilation constantly going on in the body, and which union takes place in the muscular system more acutely than in any other part of the body, produces a warmth of a most decided character, and which production does not cease with the cessation of the exercise. The manufacture of warmth in this manner is very advantageous to children, and any complaining of cold should be persuaded to warm themselves by the com-

bustion of carbon in their own frames, rather than be encouraged to obtain it by warm rooms and hot bottles to the feet, blazing fires, or any other means than by producing warmth within themselves

There is also another aspect of the case; muscular tissue wastes during long-continued rest. Any person may find this out for himself if he notes his muscular power before and after a few days of enforced confinement in bed; and there is no doubt also of the growth and increased strength of muscle by exercise. If any man changes his occupation, say from a clerk to a blacksmith, the comparison of power in the muscles of his arm at the end of a year will be found to prove this statement most efficiently; but if the blacksmith gives up his anvil and takes to the pen, within a year the powerful deltoid muscles which he formerly possessed will be dwarfed and comparatively impotent for power. Let a man or a boy have sufficient intervals of rest between his times of labour, and whether that labour is brain work or muscle work, it will tend to increase the power of the organ exercised, and the action of the one will by its own work clear the blood from the debris which has been produced by the work of the other. The more powerful minds will therefore be found among those men who do not neglect their muscular development; whilst the total neglect to mental work, which bodily labour sometimes compels the sons of toil to submit to, keeps them at a lower level in the scale of humanity than will be the case when both organs are allowed a chance by being worked alternately, as they ought to be in every well-ordained school. We must bear in mind that by exercise the individual fibres of a muscle increase in size, new molecules are developed from what are called the connective tissue corpuscules, which lie in the interstices between the fibres of the muscle. The contraction of the muscle is one of the means by which an ample supply of blood is brought for the nourishment of the new tissue. If this exercise is not forthcoming, the tissue dwindles and becomes fatty in its character, loses its proper elasticity, and does not leave room for new cells to take its place, for it is not removed in the way that a regularly-exercised muscle is. The elaboration of new muscle is the immediate effect of the activity of the old, and if the old is not used, it fails when a sudden call is made upon it.

It is however possible to carry on exercise to too great an extent, and whilst some schools ignore the necessity, others go on the wrong principle and carry it on to excess. So long as muscle conforms to what is called the principle of rythmic nutrition, its bulk and effective power increases; but long-continued over exertion tends to induce a condition of chronic exhaustion, ending in wasting and decay. There must be time between the movements for the removal of *débris* and for the recharging of the battery of nerve power which directs the movements; otherwise the symptoms which indicate muscular exhaustion come on. These are sometimes very marked when exertion is confined to a very small class of muscles. It is sometimes so marked as to constitute a distinct disease, and is called by various names, as scrivener palsy, type setters', violinists', tailors', or milkers' cramp. Various trades in which only one set of muscles is used, and used continuously for many hours together, are subject to these conditions. The causes which produce such states give us insights into the conditions which are to be avoided in the playground. 'Professional muscular atrophy' is the result of a condition which is the opposite to nonuse.

Besides the muscles which may suffer from over-exertion, the blood vessels are liable to injury. Foundations are laid for mischiefs later on in life, and dilatation of the cavities of the heart, or of the large blood-vessels allow of aneurism being set up, or the smaller arteries and veins give rise to a state corresponding to varicose veins in the leg, which are the result of too long-continued muscular exertion. Athletic exercises, therefore, may be in themselves sources of danger, and violent and long-continued work, either at cricket, or boating, or at football, or in the racket-court, must not be allowed at all to those who are not trained to it, and who have not gradually brought their powers into accord with the work they are called upon to perform.

There is an outcry at times against the continuance of violent athletic sports. It seems to me highly undesirable that they should be abolished; they ought, however, to be carried on under regulations which the monitors and masters in the school should enforce. These pastimes, when carried on in large assemblages of young men, should be under regulations supervised by a responsible officer; and racing crews, football teams, and cricket elevens, intending to enter into contest with other similar parties, should be picked out from men who have been gradually inured to the work, and who have not been absent from proper drill for any length of time together. A boy has, perhaps, been away from school on account of illness or for some temporary cause; and after an absence of two or three months, on his return takes his place at the head of his team, he enters at once into some contest in which there is a call for sudden and long continued exertion; the result is the foundation for a disease of the heart, or dilatation of some artery, which produces aneurism at some later stage of his life, or some other strain arises, the effects of which are permanent. Extreme exertion embarrasses the heart; the flow of blood is impeded from the right side of it, for the increased pressure of air upon the inner surface of the air-cells impedes the flow of blood through the lungs. These air-cells are sometimes ruptured, and that happens in the boy which is recognised in the horse when a state of things arises which leads to the condition called 'roaring.' If there has been a proper training, this does not arise. The individual is said to have gained his 'second wind;' he breathes regularly, and, under heavy and long-continued exertion, goes on properly, and he is enabled to continue up to the limits of muscular exhaustion, unless stopped by a stitch in his side. This stitch arises from the liver becoming engorged with blood, and it is unable to transmit the quantity through it which rapid exertion has brought into the venous system of the lower extremities and the bowels.

The skin flushes during active exercise, there is congestion of the cutaneous vessels, and perspiration results. This action keeps the temperature of the body at its normal standard. If the skin acts imperfectly, the accumulated heat excites languor and indisposes to further exertion, just as in the case of the lungs. If the boy is in good training the circulation goes on properly. There is not profuse perspiration, but only sufficient to carry off excess of heat. It is important, however, for boys to beware of

the dangers which may result from the custom of trying to cool themselves when too hot, by allowing evaporation to be as rapid as possible. A large loss of heat takes place in this way. The pores of the skin are suddenly closed by the cold, and the discharge of *débris*, which was taking place with the sensible perspiration, is stopped; the excretion is thrown back into the circulation in a state which does not belong to it, and, as a consequence, a condition arises which is called 'taking cold.' It really is a state of self-poisoning by returning into the circulation some morbid matter which ought not to be there at all, and which the skin was naturally excreting. When a boy is very hot, it is better not to allow this gradual chilling to take place upon any account whatever. If he has been running just before he goes into his bath, let him strip and plunge in as quickly as possible, and come out again in a very short time. The bath will refresh him, and the reaction will bring back to the skin that which was being excreted; but if the vessels are allowed to be cooled too much, they will not again relax, and there is no power to continue the process of excretion in a proper manner; the boy remains languid and tired, and it may be that a serious illness is set up. It is unwise to go into the water when in a great heat at all, unless a sudden plunge in and out is alone indulged in, in which case there is a refreshing action; but boys, as a rule, should not take violent exercise just before bathing.

Just as particular muscles may suffer from professional atrophy, so certain parts of the brain may suffer in a similar way. If a boy is kept at one form of work too long—say if he is not allowed to do anything else than try to solve some of Euclid's problems, or if he sets himself to do some such task—it is possible that there may be over-strain of that particular part of the brain upon which mathematical power may depend, and such an one will never become a reasoning genius.

Brain-work must have its rythmical movement, as muscle. There must be time for the removal of used-up brain matter, time for the renewal of new tissue, and for the recharging of the nerve battery, which has been used up in the work which has been done. Teachers are great sinners in this respect. They neglect physical exercise themselves, and, as a consequence, get a low standard of health, suffering as much as most men from these conditions, which are styled bilious, and which they connect with indigestion, but which really arises from the retention within their circulation of the *débris* of nerve tissue and the remains of used up nerve force.

Space will not allow me to go into the different forms of exercise, or to analyse the muscular movements which are brought into play in each kind. The cultivation of muscle is being recognised as a part of school work, and each in its turn becomes a useful part of muscular training. 'Training,' says an eminent writer, 'is to put the body, with extreme and exceptional care, under the influence of all the agents which promote its health and strength, in order to meet extreme and exceptional demands upon its energies'; but I have met with instances in which so-called 'training' has done everthing but this. It has not promoted health and strength, but has exhausted the bodily power, and done more mischief than good. The course of training which is recommended by the fast men of University life, or by the pugilists of fifty years ago, is not the training which boys and girls ought to submit to, except so far that the habitual use of intoxicating liquors is rightfully and reasonably prohibited; and stimulants are in no case required to produce a development of either mind or body. The requirements of a growing body are not the same as those which belong to the adult. In the one case, muscular exercise is used for the purpose of development; in the other, it is used to remove the *débris* which arises from the act of living, and in order to preserve the constitution from the dangerous result of the oxidation of this *débris* in the wrong place and at the wrong time. If one set of muscles develop in the child, and not the other, there is distortion of frame and a want of grace and of elegance in movements. The chest may be contracted, and the lungs deprived of the room which they ought to have for the necessary purification of the blood. Gymnastic and calisthenic exercises tend to produce a straight back and an upright figure; the avoidance of them may lead to round shoulders, twisted spine, stooping and shuffling gait, and shortness and imperfection of vision. The curvations of spine which are common to young girls in consequence of the want of exercise, lays the foundation of much of that mortality, or, at the least, of the acute suffering which follows upon child-bearing later on in life. Spinal curvatures are more common amongst girls than boys, because the latter do get more natural exercise than the former.

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

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No. IX.—THE THYSANURA AND NEUROPTERA.

BY some authors considered as merely a branch of the *Orthoptera*, the small and insignificant order of the *Thysanoptera*, or *Thysanura*, deserves a passing mention.

The insects belonging to this order, which are popularly known as Thrips, are chiefly remarkable for their ravages in greenhouses, etc., where, in spite of their minute size, they often cause considerable havoc. To the naked eye many of these insects are almost invisible, our largest British species barely reaching the twelfth of an inch in length. When placed beneath a tolerably high power of the microscope, however, they become very interesting objects.

The wings are seen to be curiously fringed with long tassel-like hairs, whence the title '*thysanoptera*'—*i.e.*, 'tassel-winged'—was given to the order. The parts of the mouth are of a somewhat anomalous character, the slender, bristle-like jaws resembling those of the *Hemiptera*, while the other organs are more like those of a mandibulated insect. Owing partly to this curious structure, and partly to the nature of the metamorphoses, the position of these tiny insects was for many years uncertain, but it now seems tolerably certain that they constitute a separate order, and are rightly placed in their present situation.

The thrips have occasionally caused considerable damage to the wheat crops, both in this country and on the Continent; fruit of various kinds also sometimes suffers from their attacks.

The *Neuroptera—i.e.*, 'nerve-winged' insects—may be easily recognized by the wonderfully complicated

system of nervures which supply the necessary rigidity to the wings. All winged insects possess these nervures in some form or other, but in none are they so highly developed as in the species composing this order, whose wings are divided into a vast number of small cells by the network of nerves. Generally speaking, all four wings are of equal size.

Although the *Neuroptera* are not largely represented in Great Britain, our species are, as a rule, both large and plentiful, and are therefore familiar to almost every dweller in the country.

The Stone-flies, which are so largely utilized by anglers as bait, form the first family of the order. These insects may be found in great numbers in the neighbourhood of running water, resting sluggishly upon stones and other objects upon the banks of the stream.

During the earlier stages of their existence, the stone-flies lead an aquatic life, the eggs, which are enclosed in a blackish membrane, being deposited in the water by the female insect. It is a curious fact

Larva of Dragon-fly (showing mask).

that these eggs are carried about by the parent for several days, just as is the case with those of the cockroach.

The larvæ usually conceal themselves beneath submerged stones, or in some other sub-equatic retreat, and prefer those parts of the stream where the water runs with the greatest force.

In the *Ephemeridæ*, commonly known as May-flies, we find many points of interest.

The perfect insects differ from the generality of the *Neuroptera* in the size of the hinder wings, which are considerably smaller than the anterior pair. Owing to this peculiarity, these insects have sometimes been considered as forming a separate order, to which the title of *Anisoptera—i.e.*, 'unequal-winged' insects—was applied.

Another peculiar feature of the May-flies lies in the absence of a mouth in the perfect insect. It is true that the parts of the mouth may be distinguished by the aid of the microscope, but they are only found in a rudimentary condition, and utterly unfit for the reception of food.

At the extremity of the body are seen either two or three long filaments, by means of which the insect may be readily recognized.

Although the existence of the *Ephemera* is considered at most to extend over a single day, the life of the insect in reality embraces a much longer period of time, two years being occupied in the preliminary stages of its development. The larva, which, like that of the stone-fly, is an inhabitant of the water, constructs for itself a tunnel in the mud, formed with two outlets, and very much resembling in form the capital letter U; its food consists of decaying vegetable matter.

In appearance the larva of the May-fly is somewhat remarkable, being provided with two rather long antennæ, which far exceed in dimensions those of the perfect insect; the extremity of the body is furnished with three fringed bristles, or *setæ*, and along each side of the body runs a series of thin plates, in which are the gills.

The pupa differs in outward form in a very slight degree from the larva, the chief distinction lying in

Demoiselle Dragon-flies.

the hump upon the thorax, in which are concealed the rudiments of the future wings.

When the preliminary stages of its existence are completed, a very singular circumstance takes place.

The pupa leaves the water, and, ascending the stem of some plant, undergoes its change to what we might consider the perfect insect, the wings being fully developed, and the insect possessing and using the power of flight.

Yet this, strange to say, is not its final form, for, after a short space of time, the skin again splits, and the insect crawls forth, leaving its cast-off garment behind it. The wings are now lighter, and of a more delicate nature, and the filaments at the end of the body considerably increase in length.

This intermediate stage is scientifically known as the *pseudimago*, or 'false-perfect' insect, and popularly as the 'Green Drake' of anglers, the perfect insect itself bearing the title of Grey Drake.

Once having attained to the perfect condition, the life of the May-fly is a question of only a few hours,

its existence seldom exceeding the duration of a single day.

We now come to perhaps the most interesting group of all the *Neuroptera*, namely, the *Libellulidæ*, or Dragon-flies.

Swift and active of wing, and possessed of insatiable appetites, these creatures, alike in their larval, pupal, and perfect stages of existence, are the very tyrants of the insect world, myriads of the inhabitants of the water falling victims to them while yet in the earlier stages of their existence, while the perfect dragon-flies are equally destructive among the denizens of air. Not even the swift-flying Scarlet Admiral butterfly can escape from them, its powers of flight being quite inadequate to allow of its escape from its active and vigilant foes. And the dragon-fly possesses the curious and probably unique faculty of reversing the action of the wings, and, without turning, the direction of its flight; so that it is able to pursue its quarry among the foliage of trees, etc., and thus prevent any chance of escape, while it is able to make its own retreat without the slightest difficulty.

In many parts of the country these insects are known as 'Horse-stingers,' owing to the very mistaken idea that they sting horses. There is not the slightest foundation for this idea, the dragon-fly being perfectly harmless excepting to the insects upon which it preys. It is true that, when captured and held by the wings, it will twist its long and slender body about in a manner very suggestive of the possession of a sting, and may thereby, very likely, induce its captor to restore it to freedom. But in reality there is no trace whatever of a sting, that weapon being found in some of the Hymenoptera alone, and, even then, only in the female insects.

Libellula depressa.

The life-history of a dragon-fly is of a singularly interesting and remarkable nature.

The eggs are deposited in the water by the parent insect, which may often be seen resting upon some floating object, with the tip of her abdomen dipped below the surface. The larvæ shortly hatch, and at once enter upon the predacious life which they lead during the remainder of their existence.

For this predacious life they are admirably adapted in every way.

As many of the insects, and other inhabitants of the water, are possessed of considerable swimming powers, their own locomotive apparatus must be developed in a corresponding degree. Such we find to be the case, but in a manner wholly different to what we might reasonably expect.

If we place one of these larvæ in a glass vessel of moderate size, and watch its habits for a short time, we shall be surprised at the rapidity with which it passes through the water and alters its course at will. And, more remarkable still, the means of propulsion will be absolutely invisible, the insect appearing to move without exertion of any kind.

Let us sprinkle a little fine sand at the bottom of the vessel, and we shall quickly find a clue to the mystery.

We shall see that this sand is thrown up behind the insect at tolerably regular intervals, in somewhat the same manner as if we had discharged the contents of a syringe beneath the surface of the water, although, of course, upon a much smaller scale. Now let us take the larva from the water, and subject it to close examination.

We shall find, at the extremity of the body, an appendage consisting of five spike-like objects, which can be separated and closed at the will of the insect. Concealed by these is the entrance to a passage, sufficiently large to admit an ordinary pin, which runs through the centre of the abdomen for the greater part of its length. By the agency of this tube the insect is enabled to swim.

It will be seen that, if the tube is filled with water, and suddenly compressed, the force of the expelled fluid upon the surrounding water will propel the insect forward, just as a sky-rocket is driven into the air by the action of the ejected gases upon the atmosphere. This is the whole secret of the swimming powers of the dragon-fly larva, the tube being alternately filled with water and forcibly compressed by the powerful muscles of the abdomen.

The swimming tube also fulfils a second and equally important function, somewhat analogous to that performed by the gills of a fish.

Although the dragon-fly larva requires a constant supply of oxygen, it is yet not obliged to seek it at the surface, as are the generality of water insects, but is enabled to extract the requisite amount from the water by means of the swimming tube. In the interior of this are placed the spiracles, instead of upon the outer surface of the body, as is usually the case.

Beneath the head of the dragon-fly larva, and extending as far as the junction of the first pair of legs with the thorax, will be noticed a curious horny plate. This can be unfolded by means of a pin, and will then be seen to consist of several joints, the last of which is furnished with a pair of powerful jaws.

This apparatus, which is known as the 'mask,' is used in seizing the prey. Swimming silently beneath its intended victim, the dragon-fly larva approaches within striking distance. The mask is then thrown sharply upwards, and the insect seized in the horny jaws. Once captured, the mask is contracted, and the victim held against the mouth, where it is retained until completely devoured.

This larva is not a very handsome creature, being a slender insect, of a pale olive-brown colour, with rather long legs. The pupa is but little different, the methods of eating, breathing, and swimming being precisely the same, and the only apparent alteration

consisting in the appearance of a hump upon the thorax, in which the future wings are enclosed.

When the time approaches for its change into the perfect condition, the pupa becomes sluggish and entirely loses its appetite. Warned by instinct, it crawls up the stem of some water-plant, leaves its late element behind it, and emerges into the air, where it rests for a few moments, clinging tightly to its foothold.

After the lapse of a few minutes, the skin bursts, and the dragon-fly crawls forth, its wings still limp and crumpled, and as yet unfit to bear their owner through the air. By degrees, however, the folds disappear, the membrane acquires the necessary strength, and the dragon-fly launches itself into the air, and immediately sets forth in search of prey. Although its development is completed, its appetite is as voracious as ever, and insect after insect falls a victim to its insatiable hunger. Even if captured and held between the fingers, it will continue to feed, and will devour more bluebottles than its captor will care to supply.

We have many species of dragon-fly in this country, most of which are plentiful, and may be seen in numbers towards the end of summer flying over almost any pond. The pretty Demoiselles, seeming almost fairy-like in their delicate grace, the yellow-bodied *Libellula depressa*, and many others, may be seen hawking for prey, passing from place to place with the most wonderful rapidity, and ever and anon capturing a hapless insect, which is devoured almost as soon as fairly seized.

As is the case with many of the most brightly-coloured insects, the tint of the dragon-flies, brilliant as they are during life, fade and often entirely disappear in death. A collection of dragon-flies, therefore, can give no idea of the beauty of the living insects, the reds and greens and blues all merging into the one uniform tint of brown. No method of preventing this alteration has yet been discovered, and it would seem that the only way to do so would be to take the insect to pieces, carefully paint the interior, and join the fragments again with cement. Even this process, however, would probably prove unsatisfactory, and the dried specimens would present a very different appearance to the living insects as they sport in the sunshine.

Many interesting foreign insects, such as the Ant-lion and the Termite, or, as it is wrongly termed, the White Ant, belong to this order; but, as our space is limited, we must pass them by and turn to another of our British *Neuroptera*, namely, the Lacewing Fly (*Chrysopa vulgaris*).

This exquisite insect may often be seen flying in the dusk during the summer months, looking on the wing very much like a small white moth. When captured, however, it is seen to be of a pale green colour, with iridescent wings, various tints playing over them by turns.

The eye of the lacewing fly is a truly wonderful object, far surpassing both in brilliancy and depth of colour that of any other insect.

So graceful and delicate an insect would secure unmingled admiration were it not for one most unpleasant property it possesses, *i.e.*, the power of exuding a liquid of the most nauseous and penetrating odour that can possibly be imagined. A mere touch is sufficient to bring out this evil perfume, and even repeated ablutions will hardly lessen its potency, several days sometimes elapsing before its traces finally disappear.

The lacewing is one of our many unrecognised insect benefactors, the larva uniting with the various ladybirds in their attacks on the destructive aphides. It has the peculiarity of clothing itself with the skins of its victims, after sucking their juices, in such a manner that its form is almost entirely concealed. Its ravages are, however, not entirely confined to those mischievous little insects, for it will even devour its own comrades, should they happen to meet with one another.

The ova are deposited in a somewhat remarkable manner, each egg being fastened upon a separate footstalk, half an inch or so in length. These footstalks are formed from a viscous fluid secreted by the parent insect, a minute drop being exuded upon a twig or some other object, and the body suddenly withdrawn. The gummy fluid is thus drawn out into a thread, upon the extremity of which the egg is placed.

A number of these eggs are always placed together, and present a very curious appearance, closely resembling the capsules of various mosses. Indeed, by many authors they have been considered as mosses, and described and figured accordingly.

(To be continued.)

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Anecdotal Natural History.

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No. XI.—THE ELEPHANT.

THE Elephant belongs to the curious family of the Pachyderms, or 'thick-skinned' animals, which also includes such apparently dissimilar creatures as the little Hyrax, or 'Coney' of the Scriptures, and the various swine.

At first sight, and judging by their outward forms, these animals do not appear to have very much in common, and it may seem somewhat strange that they should have been included in the same family. An examination, however, of the fossil animals of the group supplies the requisite links, and affords conclusive proof that all these animals really belong to one and the same division.

As is well known, there are two distinct species of elephant, the one inhabiting Africa, while the other is a native of various parts of the continent of Asia. As far as their chief characteristics are concerned, the two animals are sufficiently alike to allow of a single description sufficing for both.

The most singular part of the structure of the elephant is, of course, the proboscis, or 'trunk' as it is popularly called, upon which the very life of its owner depends. This wonderful organ is, in reality, merely a development of the nose and the upper lip, the nostrils running through its entire length. The extremity is furnished with a curious finger-like appendage, which is of so delicate a nature that it can pluck a single blade of grass if required.

The proboscis is formed alike for strength and flexibility, and is provided with the enormous number

of fifty thousand distinct muscles, some running longitudinally along the proboscis, while others radiate from its centre.

Upon the proboscis the entire nourishment of the animal depends, and, were it deprived of that organ, starvation would inevitably ensue. The short and thick neck would prevent it from grazing, while the long tusks would hinder it from devouring the herbage which grew on a level with its body. Water, also, could no longer be obtained, and thirst and hunger combined would shortly end the sufferings of the mutilated animal.

In somewhat the same manner as the camel, the elephant possesses the faculty of storing up water in the interior of the body, and is, moreover, able to withdraw it when required by means of the trunk, and sprinkle it over the body, in order to cool the heated surface.

The method of drinking is somewhat peculiar. Inserting the tip of the trunk into the pool, the animal sucks a quantity into its cavities; the proboscis is then reversed, the end placed in the mouth, and the fluid discharged down the throat.

In providing food, too, the trunk answers much the same purpose, first plucking the leaves, etc., and then placing them in the mouth.

The head and skull of the elephant are formed in a very curious manner, affording a most wonderful example of strength combined with lightness. The former quality, of course, is indispensable, the enormous weight of the tusks and proboscis necessitating the provision of large and powerful muscles, while the advantage of the latter is self-evident.

In order to satisfy these demands, the bony plates which form the skull are separated from one another, and form a series of cells, each of which contains a number of smaller chambers, bearing, in fact, a considerable resemblance to a honeycomb. These cells are filled with a thick oily fluid.

In the midst of these cells lies the brain, which is remarkably small in comparison to the size of the animal, and is thus protected from the effects of the various concussions it would inevitably receive during the headlong rushes of its possessor.

In like manner, too, this structure protects the animal in a great measure from the bullets of the hunter, for, unless they should happen to enter by the eye, the ear, or the nostrils, the leaden missiles stand but little chance of reaching the brain, burying themselves in the cellular mass, and doing comparatively little damage. An elephant has been known to receive between twenty and thirty large balls in the head alone before finally succumbing to its wounds.

It is, however, a somewhat curious fact that the skulls of the African and the Asiatic elephant are not formed exactly in the same manner, although the curious cellular structure is found in both, so that a bullet, which to the one would cause little injury, would to the other be certain death.

For example. If a hunter stands in front of an Indian elephant, and sends a bullet into the spot where the proboscis joins the head, the animal falls dead without a struggle, the bullet having penetrated to the brain. But if he were to attack an African elephant in the same manner, the bullet would pass above the brain, and waste itself in the cells of the skull, only irritating, and not injuring the elephant.

The limbs of the elephant, also, are admirably adapted to sustain the immense weight of the animal. Stout, and comparatively short, they are set perfectly upright, like so many pillars; the hinder pair, also, are without the elongated cannon-bone, so that the so-called 'knee-joint' is absent, while the real knee is very conspicuous.

The elephant is a far more active animal than might be supposed, judging by outward appearance, his speed when excited being almost equal to that of a fleet horse. On rocky and mountainous ground, too, he is perfectly at home, notwithstanding his bulky proportions, and will ascend and descend acclivities where a horse is utterly unable to gain a foothold.

His method of descending precipitous ground is very singular. Kneeling down, with the fore legs stretched out in front and the hinder ones bent backwards, he gradually lowers himself towards the ground, making use of every little inequality in the surface, or scraping a foothold with his hoof, should a convenient one not be otherwise attainable. If the declivity be very steep, he pursues a winding course, just as does a horse in ascending a hill.

The foot of the elephant is wonderfully suited to the work it has to perform. The hoof which encloses it is formed of a vast number of horny springs, similar to those found in the hoof of the horse, which protect the foot from any concussion against the ground, and enable the animal to move with surprising ease and silence. Notwithstanding the huge bulk of the body, the tread of an elephant is perfectly noiseless, and as the animal possesses the faculty of forcing its way through the thickest jungle without snapping even a twig, a hunter may be in close proximity to a herd of moving elephants, and yet not be in the slightest degree aware of their presence.

The toes, five of which are found in each foot, are almost entirely encased in the hoof, and are only partly visible to outward inspection.

The tusks of the elephant vary according to the sex, age, and species of the animal, being most highly developed in the male of the African variety. They do not, as might be imagined, spring from the jaw itself, but, like the teeth of the bottle-nosed whale, proceed from a vascular formation found upon the gums.

The molar teeth appear to be formed of a number of smaller teeth, which are closely fastened together, so as to form a single large mass. These are set obliquely in the jaws, and are gradually worn away by constant use, fresh teeth taking their places as often as required. In this manner, an elephant may have seven or eight sets of teeth, each set increasing in size in proportion to the growth of the animal. The incisors, which are found in the upper jaw only, are long and projecting; the canines are altogether wanting. The size of the elephant is generally much exaggerated, even a large animal seldom exceeding ten feet in height, while the average is a foot or so less.

The elephants of both continents alike are almost invariably found in herds, varying considerably in point of number, which are always under the guidance of some old and experienced leader. They dwell in the thickest forests, being seldom found at any great distance from water.

During the drought of summer, of course, the smaller streams often run dry. In such cases, the reasoning powers of the animals come to their assistance, and the elephants, as Sir Samuel Baker tells us, in

his well-known work 'Eight Years in Ceylon,' 'make use of their wonderful instinct by digging holes in the dry sand of the river's bed; this they perform with the horny toes of their fore feet, and frequently work to a depth of three feet before they discover the liquid treasure beneath.'

WE will now devote our attention to a description of the habits, etc., of each of the two species, taking the Asiatic animal first in succession.

This elephant may be at once distinguished from its African relative by the size and form of the ears, those organs being in the Asiatic animal proportioned to the dimensions of other parts of the body, whilst in the African variety they are of very great comparative size, almost meeting at the back of the head, and hanging considerably below the neck. An African hunter has been known to shelter himself under an elephant's ear during a storm, and to emerge perfectly dry when the storm had passed over. The head of the former, also, is elongated, and the forehead concave, while in the latter the very reverse is the case.

Another point of distinction, too, is found in the molar teeth, the enamel upon the surface of those of the Asiatic elephant being moulded into a number of narrow bands, while in the African species it is formed in a series of diamond-shaped folds.

In the Asiatic species, too, the tusks are found only in the males, and are not possessed by every member of even that sex. When present, they are, generally speaking, very much inferior both in size and quality to those of the African animal.

The Asiatic elephant is chiefly remarkable for its services to man when trained to do his bidding. In all work which necessitates the employment of great strength united with intelligence, the value of the animal is inestimable. In such operations, for instance, as piling logs, laying dams, or even building walls, elephants are largely employed, their enormous strength and quick judgment rendering them most valuable auxiliaries.

These advantages are, however, not unmixed with drawbacks. The health of the animal, for example, requires constant care and attention; the skin, thick as it is, is liable to abrasions, resulting in ulcerous sores; and the eyes are constantly subject to inflammation.

Taking these disadvantages into consideration, many writers are of opinion that the value of the elephant as a beast of burden is greatly over estimated, and that he is in reality of little more use than a powerful dray horse, which can work for longer hours, and is not so subject to sores and inflammations.

As far as some of the operations performed by elephants are concerned, this theory may be true enough, but when we consider the enormous weights which these animals are accustomed to carry, and the precision with which the largest and heaviest beams are placed by them, it seems hardly possible that their duties could be adequately performed by any other animal, no matter how powerful and intelligent it might be.

Another of the manifold purposes for which the Asiatic elephant is employed is that of an auxiliary in the chase of the tiger.

In order to serve in this capacity, the animals are captured when very young, and are carefully trained to perform their future duties. This is no easy task, for in the very nature of the elephant there appears to be an ingrained dread and abhorrence of the tiger, causing it to fly in terror from the mere sight of the skin of the fierce beast.

The education, therefore, of the hunting elephant is a matter of care, time, and patience, and is conducted as follows.

A tiger-skin is procured and stuffed, in order to resemble as far as possible the form of the living animal. This is continually presented to the elephant until he loses his natural fear of the striped skin.

The next step is to teach the animal to gore his foe with his tusks, and trample him under foot.

Next, a boy is placed inside the skin, in order to counterfeit the motions of the living tiger, and, finally, a dead animal is substituted for the stuffed skin.

Yet, with all the preliminary training, the elephant is seldom to be depended upon in the hour of actual danger, the rush of the furious tiger often causing the huge animal to turn tail, and fly before the onslaught of its foe.

During these expeditions, the animal is guided by a driver, or 'mahout,' who sits astride upon the neck, directing the animal by means of a spiked-hook, or 'haunkus,' which is placed against the head of the elephant in such a manner as to convey the driver's instructions to the animal. The hunters ride in a 'howdah,' or car, which is fastened upon the elephant's back.

The elephants intended for domestication are captured in two ways. In the first of these, 'koomkies,' or trained female elephants are employed, which divert the attention of the intended captive from his approaching foes, who even creep beneath his body without alarming him, and place nooses of strong rope round his limbs. The ropes are then fastened to convenient trees, the koomkies called off, and the elephant finds himself a prisoner. For a time he struggles to release himself from his bonds, but finally yields to his captors, and is led off to a place of security.

The second method of capturing the elephants is of a far more comprehensive nature, all the members of one or more herds being included in the attack.

For this purpose a large enclosure, or 'keddah,' is formed of stout posts, which are driven into the ground at such a distance from one another as to allow a man to pass freely between them. A head of elephants is then surrounded by hunters, and gradually driven towards the keddah, the door of which is left open.

By slow degrees, the operation sometimes extending over several weeks, the animals are forced into the enclosure, the entrance to which is immediately closed.

Should the animals attempt to burst from their place of confinement, they are immediately driven back by torch-bearers, who thrust their flaming brands into the faces of the excited captives, and deter them from breaking through the walls. After a time, the imprisoned animals relax their efforts to escape, when the hunters cautiously enter, and bind each of them securely to a tree, or other immovable object.

The nature of the Asiatic elephant is, as a rule, very quiet and peaceable, forming a great contrast to the fierce and savage character of its African relative.

Even when hunted, if it should be successful enough to strike down its foe, the animal seems to have little idea of revenge, and usually contents itself with kicking its prostrate adversary from foot to foot without causing any great injury.

It may seem remarkable that a domesticated animal should be desirous of reducing its fellows to a state of servitude. Yet the elephant does so, the females using every means in their power to capture the males.

One case is known where a female escaped from her owners, carrying with her a chain. In a few days she returned, and by signs and sounds told her keepers that she wished them to accompany her into the forest. This was done, and then she led them to a spot where a fine male elephant was found chained to a tree. In fact, she had acted the part of Delilah towards Samson.

THE African elephant (*Elephas Africanus*) is spread over a large tract of country, extending from Abyssinia to the borders of Cape Colony. Like the Asiatic species, it is an inhabitant of the thick forests, seldom venturing into the open country.

This elephant is also much sought after, although from very different motives to those which influence the hunter of the Asiatic animal.

The natives of Africa are either not aware of the services rendered by the elephant when captured and carefully trained, or mingled apathy and fear prevent them from availing themselves of their opportunities. Just the same is the case with the Chetah, or Hunting Cat, which in Asia is carefully trained for purposes of the chase, while in Africa it is allowed to remain in freedom. Formerly, however, the African elephant was trained for purposes both of war and peace, just as is now the case in India.

The ivory of the tusks forms the principal incentive to the efforts of the hunters engaged in the chase of this animal, being of very fine quality and considerable value. An ordinary pair of tusks, weighing, perhaps, rather over a hundredweight, will fetch thirty-five or forty pounds, although the price varies slightly according to the condition of the market.

The flesh, too, is by no means an unimportant article of diet, especially among the natives, to whom the slaughter of an elephant is an occasion of great rejoicing. Some parts, such as the foot, are justly considered as especial dainties, but the greater portion of the flesh is stated by many travellers to be little superior in toughness and flavour to ordinary shoe-leather.

The foot is baked in a somewhat curious fashion. A fire is lighted upon the ground, and allowed to burn itself out. A hole is then dug beneath the spot, and the foot is inserted, being then covered up with the warm earth. A second fire is then lighted, which is also suffered to burn itself out, and when the earth is thoroughly cool, the process is complete, and the dainty in perfect order for the table.

Until the advent of firearms, the slaughter of an elephant was only a very occasional event with the natives, who were either obliged to follow it for days, attacking it with their spears at every opportunity, until the animal fell from sheer exhaustion and loss of blood, or to trap it by means of pitfalls.

These latter are still employed, being dug in the paths of the animals, and covered over with boughs and earth to imitate the surrounding surface. With the old and experienced leaders, however, these precautions are of little avail, for the crafty animals test every inch of ground with their trunks before trusting their weight upon it.

Should one of the animals, however, be unfortunate enough to fall into the snare, it has no chance whatever of escape, a sharp upright stake being fixed in the centre of the pit, upon which the luckless creature is impaled by its own weight.

In their wild and free state, it is probable that elephants live to a very great age, and even when domesticated, appear to be long-lived animals; there have been several apparently well-authenticated instances of these animals attaining the age of two hundred years.

(To be continued.)

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'How I Teach Elementary Science.'

BY RICHARD BALCHIN,
Head Master of the Gloucester Road Board School, London.

FOURTH SCHEDULE SUBJECTS: MECHANICS.

I PROPOSE in this article reproducing one of the lessons in the second stage; subject:—'Velocity or rate of motion; measure of velocity; accelerated, retarded, and uniform velocity.'

Here is a picture, Jones; what does it seem to be a picture of? Ans.—Two men walking. Can any boy tell me something else about it? Ans.—One man is carrying a very small bag, and walking fast. The other has a heavy load on his back, and seems to be going slowly. Can you see anything else in the picture? Ans.—A train going over a bridge. What would you say about the bag the man is carrying? Ans.—It is very small; very light. And about the load? Ans.—It seems to be very heavy. Can you tell me *how* light the bag is? Ans.—About three or four pounds. Yes, I should think about that. And the load? Ans.—About thirty or forty pounds. Well, I should say about sixty. Look at this feather; see how slowly it falls to the ground; why is that? Ans.—Because it is so light. Would the little bag do so? Ans.—No, sir. Why not? Ans.—Because the bag is heavy. Indeed; you just said the bag was light? Ans.—Yes; the bag *is* light compared with the load; but it is heavy compared with the feather. Just so. You see, therefore, that the words 'light' and 'heavy' only show the weight in relation to something else. If we wanted to state exactly *how* light or *how* heavy each of the things is, what terms must we use? Ans.—We must say how many pounds or how many ounces it weighs. Yes; in other words, we must use some measure of weight. Now, you just said that one man was walking fast and the other slowly. But look at the train, see the long line of steam and smoke it leaves behind. Is the man with the bag going fast as compared with the train? Ans.—No, sir; quite slow. Yes, that is true; but as compared with the man who has the load what would you say? Ans.—He is going fast. Just so. You see, therefore, that 'light' and 'heavy,' 'slow' and 'fast,' are terms used relatively. We say they are 'relative terms.' I will write that on the board. Now can you tell me exactly *how* fast the one man is

walking, or *how* slowly the other is moving, or *how* fast the train is travelling; just as you said how much the bag or the load weighed? No answer. (A boy)—We want a measure. Do you? A measure of what? Ans.—Of the rate they are going. Can you give me *one* word for 'rate they are going?' Ans.—Quickness; speed; 'motion.' Some boy said 'motion;' but in our last lesson, what did we agree that 'motion' should mean? Ans.—Change of place. Yes; so we must not use it for rate or speed with which anything changes its place. I will give you the proper word and write its meaning:—'Velocity or rate of motion.' Now what we want is a measure of velocity. If we have such a measure, what will it enable us to say respecting the motion of these two men and the train? Ans.—Exactly how fast they are going. And without such measure what is the only thing we can say? Ans.—Only how fast one is going as compared with the other. Yes; what were the terms I told you we should use in this latter case? Ans.—Relative terms. You remember last week we used a word in a sense almost the opposite of relative, what was it? Ans.—Absolute. Just so. Now tell me in what terms we want to speak of the velocities represented in that picture? Ans.—Absolute terms. But in order to speak in absolute terms, what is it we require? Ans.—A measure of velocity. (A boy, putting up his hand)—Please, sir, how can you measure motion? Well, that is what I was about to ask you. Can you weigh velocity? No, sir. Why? Ans.—Because it is not matter. (A boy)—You can measure in feet or in miles the distance anything goes. Yes, you can; but what of that? Ans. (from the same boy)—If the man with the bag goes two miles, and the man with the load goes only one mile, the velocity of the first man is double that of the second. (A boy)—That does not show anything about the velocity they go at, at all. That shows only how far they go. Exactly so, Smith; and can you prove to that boy that what he has said has nothing to do with velocity? Ans.—Yes, sir; I think I can. The first man may take two hours to go his two miles, while the second man may do his one mile in half-an-hour. Quite so; and in that case which one would move with the greatest velocity? Ans.—The second one. Yes; what, therefore, is it we must know if we want to measure velocity, besides the distance passed over? Ans.—The time it takes to go. True: now tell me how we measure velocity? Ans.—By the distance passed over in a certain time. Right: then tell me how you would state the velocity of that train? Ans.—A mile a minute: sixty miles an hour. Yes. We have on the board, you see, 'velocity is rate of motion;' I will write under it:—'It is measured by the space passed over, in a given time.' Have any of you boys ever bowled an iron hoop down a hill? Ans.—Yes, sir. Ah! I remember when I was a boy like you, I was very fond of going up Primrose Hill—that is the name of a little hill just outside of London, on the north—and after tying a white rag to my hoop, send it flying down the hill, while I stood at the top and watched it. Away it would go, at such a rate. I shouted and clapped my hands as I saw it flying away, quicker and quicker, until it got into the level field at the bottom; then it went more than half-way across the field, getting slower and slower, until at last it stopped. Then I would run down myself—so fast; getting up such a rate by the time I got to the bottom; where I generally managed to fall down, roll over and over, and at last stop. I would at once take the hoop to the top again; it was such fun. Now, can you tell me what was the difference between the way the hoop went down the hill, and the way it went when on the level field? Ans.—It went very quickly down the hill, but rather slow across the field. (Another boy)—It went quicker and quicker while it was on the hill, but when it got to the field, at the bottom, it went slower and slower. Just so. Suppose I could notice exactly how many feet the hoop went in any one second down the hill: say in a certain second it went twenty feet; would it travel more or less than twenty feet in the next second? Ans.—More. Yes, I daresay it would go thirty feet; and in the next second still further. Now, for that kind of velocity we have a name, which very likely you have never heard before, so I will write it on the board: 'accelerated velocity.'

You said, that when the hoop came to the level field, it began to go slower and slower, and then stopped. Suppose we noticed exactly how many feet it went in, say the twentieth second before it stopped, and found that in that second it travelled ten feet: in the next second, that is the nineteenth second before it stopped, would it, think you, go more or less than ten feet? Ans.—Less. Why do you think so? Ans.—Because it keeps getting slower and slower. Very true; perhaps it would only travel eight or nine feet; and in the next second still less, and so on, until it stopped. Have you ever heard of the name we give to this kind of motion? Ans.—Retarded velocity. That is quite right, Jones, but how did you come to know that word, I don't think I have mentioned it before in my lessons? Ans. (from Jones)—I read it in our sixth standard reading books. Good: I am quite pleased with you, my boy, for thinking of what you read. Well, I will write this term on the board: 'Retarded velocity.' Now, boys, give me some instances of accelerated velocity? Ans.—A truck running down an incline. Some water running down a steep place. A stone falling to the ground. The bucket going down the well when you let go the handle. Yes, and what as to the handle running round? Ans.—That is accelerated velocity, too. Now, give me some instances of retarded velocity. Ans.—Anything going along level ground. A stone thrown up into the air. Just so, but when does this retarded velocity come to an end? Ans.—When the stone has gone up as high as it will go. Yes; and then what kind of velocity will the stone fall with? Ans.—Accelerated velocity. (A boy holding up his hand.) Well? Please sir, what is the name of the velocity when the thing goes neither quicker and quicker, nor slower and slower; when its goes along all the same? Well, now, do you know of any such velocity? Ans.—Yes, sir; if a train keeps going a mile a minute. Can any boy give me another instance of such velocity? Ans.—The earth going round the sun. Yes, that is very nearly the same. What term, think you, we might apply to such? Ans.—Even velocity. Yes, 'even' is a very good name for it; but I will write on the board the one generally used:—'Uniform velocity.' You spoke just now of a train; tell me what kind of velocity it has on starting? Ans.—Accelerated. And when it is at full speed? Ans.—Uniform. And when the guard puts on the brake to stop it? Ans.—

Retarded. Very good; now I think you may take out your books and write:—Velocity is rate of motion; it is measured by the space passed over in a given time. Accelerated velocity means continually increasing spaces passed over in equal times. Retarded velocity means continually decreasing spaces passed over in equal times. Uniform velocity means equal spaces passed over in equal times. End of lesson. I may here remark, that I always get the boys to learn from memory, the definitions and facts that are written in their exercise books. I need scarcely say, that no printed text-book whatever is put into the hands of the boys.

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Pupil Teacher's Examination Questions.

NOVEMBER, 1881.

CANDIDATES.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. If a pole 10 feet high cast a shadow 12 feet 8 inches long, how high is a tower which casts at the same time a shadow 57 feet long?
2. Compare the cost of 150 oranges at 9½d. a dozen, and that of 3½ lbs. of tea at 2s. 10½d. a lb.
3. Find the total cost of the following:—
   3019 articles at 18s.
   517 articles at £1 18s.
   2466 articles at 16s. a dozen.
   620 dozen at £2 4s. per score.
4. How many yards worth 3s. 7½d. should be given in exchange for 935½ yards worth 18s. 1½d. per yard?
5. 518 ac. 3 rd. 7¾ poles at £118 7s. 6d. per acre.

FEMALES.

1. Make out the following bill:—
   81 yds. silk at 3s. 9d. per yd.
   225 yds. flannel at 1s. 7d. per yd.
   108 yds. serge at 1s. 8d. per yd.
   45 umbrellas at 11s. 6d. each.
   51 prs. of silk stockings at 10s. 7d. per pr.
   360 prs. of gloves at 1s. 2½d. per pr.
2. Find the cost of 7551 articles at £3 15s. 2½d. each.
3. 37 cwt. 2 qrs. 13 lbs. at £4 14s. 6d. per cwt.
4. What is the value of 10,060 articles at one shilling and elevenpence halfpenny each?

Grammar.

1. Parse all the nouns, verbs, and adjectives in the following:—

   'It ceased, the melancholy sound,
   And silence sunk on all around;
   The air was sad, but sadder still
   It fell on Marmion's ear,
   It plained as if disgrace and ill,
   And shameful death, were near.' SCOTT.

   Point out and parse all the adjectives and adverbs in the above.
2. Give two examples of verbs in the imperative, and two of verbs in the subjunctive mood.
3. What adjectives are compared by adding *er* and *est* to the positive?

Geography.

Answer two questions.

1. Name in order the river-mouths, bays, headlands, and principal seaports between the Firth of Forth and the mouth of the Thames. Describe briefly the character of each seaport.
2. What differences of climate are there between the east and the west sides of Great Britain? Give reasons for these differences.
3. Say what you know about the physical features and industrial pursuits of Devonshire, Cumberland, and Aberdeenshire.

If you can, draw a map to illustrate *one* answer, and insert the lines of latitude and longitude.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

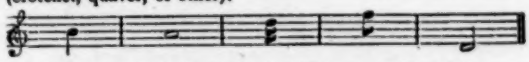
Write in large hand, as a specimen of copy-setting, the word *Geraldine*.

Write, in small hand, as a specimen of copy-setting, *The Programme of Proceedings*.

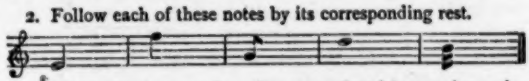
Music.

A quarter of an hour allowed for this paper.

1. Write, over each of the following notes, its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other).



2. Follow each of these notes by its corresponding rest.



3. How many tones and semitones are found in a major scale, and what places therein do the latter occupy?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

1. 12 ft. 8 in. = 152 in.
   57 ft. = 684 in.
   152 in. : 684 in. :: 10 ft. : height of tower.
   10 ft. × 4½ = 45 ft.

2. (*a*) 150 at 9½ per doz. = 12½ doz. at 9½d. each = s. 9, d. 10½
   (*b*) 3½ lbs. at 2s. 10½d. = 10 0½
   (*a*) is less than (*b*) by 2d.

3.

	£	s.	d.
3019 arts. at 18s. = (£3019 − 1/10 of £3019) =	2717	2	0
517 ,, £1 18s. = (£1034 − 1/10 of £517) =	982	6	0
2466 ,, 16s. per doz. = (2466 at 1s. 4d. ea.) =	164	8	0
620 doz. at £2 4s. per score = 372 at £2½ =	818	8	0
Total cost =	4682	4	0

4. 18s. 7½d. being = 5 times 3s. 7½d., ∴ 5 times 935½ yds. must be given in exchange, *i.e.*, 4677½ yds. Ans.

5. Value of 1 ac.

	£	s.	d.
	= 118	7	6 × 8
			10
	1183	15	0 × 1
			10
	11837	10	0
			5
	59187	10	0
	1183	15	0
	947	0	0
,, 518 ac.	= 61318	5	0
,, 2 ro. = ¼ val. of 1 ac.	= 59	3	9
,, 1 ro. = ½ ,, 2 ro.	= 29	11	10½
,, 5 po. = ½ ,, 1 ro.	= 3	13	11¼
,, 2½ po. = ½ ,, 5 po.	= 1	16	11¼
,, ¼ po. = 1/10 ,, 2½ po.	=	3	8¼
,, 518 ac. 3 ro. 7¾ po.	= £61412	15	3¾ Ans.

FEMALES.

1.

		£	s.	d.
81 yards	at 3s. 9d.	= 15	3	9
225 ,,	,, 1s. 7d.	= 17	16	3
108 ,,	,, 1s. 8d.	= 9	0	0
45 umbrellas	,, 11s. 6d.	= 25	17	6
51 pairs	,, 10s. 7d.	= 26	19	9
360 ,,	,, 1s. 2½d.	= 21	15	0
		116	12	3 Ans.

2. Value of whole at £1 = £7551 0 0
3
,, £3 = 22653 0 0
,, 10s. = ½ val. at £1 = 3775 10 0
,, 5s. = ½ ,, 10s. = 1887 15 0
,, (1s. = ⅕ ,, 5s.) = (377 11 0) *to be omitted in adding.*
,, 2d. = 1/12 ,, 1s. = 62 18 6
,, ½d. = ¼ ,, 2d. = 7 17 3¾
,, £3 15s. 2¼ = 28387 0 9¼ Ans.

3. Value of 1 cwt. = £4 14 6 × 1
6
28 7 0
6
170 2 0
4 14 6
,, 37 cwts. = 174 16 6
,, 2 qrs. = ¼ val. of 1 cwt. = 2 7 3
,, 14 lbs. = ¼ ,, 2 qrs. = 0 11 9¾
,, 37 cwt. 2¼ qrs. = 177 15 6¾
subtract ,, 1 lb. = 1/28 of 14 lbs. = 10½
∴ ,, 37 cwt. 2 qrs. 13 lbs. = 177 14 8¼ Ans.

4. 10,060 arts. at 1s. 11½d. = 10,060 at 2s. – 10,060 halfd.
= 1/20 of £10,060 – 5,030d.
or 419s. 2d.
= £1006 – £20 19s. 2d.
i.e., £985 0s. 10d.

Grammar.

1. Parsing of *nouns*, *verbs*, *adjectives*, and *adverbs*.
ceased—intrans. reg. verb, indic. past indef. 3rd pers. sing., agreeing with subj. *it*.
melancholy—qual. adj. limiting *sound*.
sound—abstr. noun, neu. sing. nom. in apposition with *it*.
silence—abstr. noun, neu. sing. nom. subj. of *sunk*.
sunk—(= sank), intrans. v. irreg. *sink*, *sank*, *sunk*, indic. past indef., 3rd pers. sing. agr. with *silence*.
all—an adj. used for a pronoun.
around—adv. (modif. 'stood' or other verb).
air—abstr. noun, neu. sing. nom. subj. of *was*.
was—irreg. subst. v. *am*, *was*, *been*, indic. past indef. 3rd pers. sing. agr. with *air*.
sad—adj. limiting *air*, used predicatively.
sadder—adv. compar. deg. modif. *fell*.
still—adv. of degree, modif. *sadder*.
fell—intrans. v. irreg. *fall*, *fell*, *fallen*, indic. past indef. 3rd pers. sing. agr. with *it*.
Marmion's—prop. noun, mas. sing. poss. attrib. to *ear*.
ear—com. noun, neu. sing. obj. gov. by *on*.
plained—(= complained), intrans. reg. v. indic. past indef. 3rd pers. sing., agr. with *it*.
disgrace—, *ill*—, *death*— } abstr. nouns. neut. sing. nom. subj. *were*.
shameful—qual. adj. limiting *death*.
were—irreg. subst. verb, *am*, *was*, *been*, subj. past indef. 3rd pers. plur. agr. with *disgrace*, *ill*, *death*.
near—adv. modif. *were*, used predicatively.

2. Two examples of verbs in the *imperative mood*—*Read* this. *Stand* at ease; *subjunctive*—*Wert* thou in the cauld blast, I'd shelter thee. I fear lest he *come*.

3. (*a*) Adjectives of *one* syllable are generally compared by *-er* and *est*, as long, longer, longest; safe, safer, safest.
(*b*) *Dissyllables* ending in *-y* (changed into *-i* before -er and -est), *-ble*, *-er*, and *-ow* frequently add *-er* and *-est*; as—happy, happier, happiest; tender, tenderer, tenderest; shallow, shallower, shallowest.
(*c*) Adjectives of all terminations accented on the second syllable often take *-er* and *-est*; as—complete, completer, completest; divine, diviner, divinest.

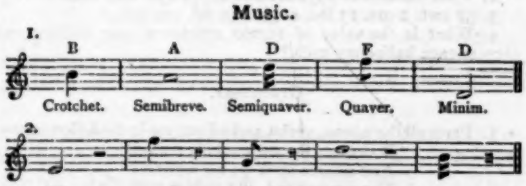
Geography.

1. The river-mouths, etc., between the Firth of Forth and the Mouth of the Thames are—*St. Abb's Head*, *Mouth of the Tweed*, *Mouths of the Wansbeck* and *Blyth*, *Mouth of the Tyne*, *Newcastle*, great seaport for coal, *Sunderland* at the *mouth of the Wear*, next to Newcastle as a coal port, *Stockton* at the *mouth of the Tees*, has great Baltic trade, *Flamborough Head*, *Bridlington Bay*, *Spurn Head*, *Humber Mouth*, *Hull*, the third seaport in England, trading with the Baltic and the Mediterranean, *Boston* has considerable trade with London, and stands at the *mouth of the Witham*, *the Wash*, receiving the waters of *the Trent* and *the Ouse*, *Hunstanton Ctiff*, *Yarmouth* at the *mouth of the Yare*, the great centre of the English herring-fishery, whence herrings are sent to London, the Mediterranean, and the West Indies, *Lowestoft Ness*, *Harwich*, one of the best seaports on the east, at the *mouth of the Stour*, *mouth of the Chelmer*, *the Naze*, *Foulness*.

2. The mountains of the west act as a screen to protect the eastern plains on that side where they are in danger of excessive rainfall, which would injure the crops. As heavy masses of clouds are driven up from the Atlantic, they are caught by the mountain heights, lose their moisture, and originate some considerable rivers. The barren hills on the west are almost continually shrouded in mist, while the districts beyond them receive only the proper amount of water. These facts render the climate of the east coast less mo st than that of the west.

3. *Devonshire* occupies that portion of the south-western mountain group where the moorlands rise to their greatest height and present their wildest scenery.
The county is naturally divided into three parts: (1) *Exmoor*, a high table-land, covered with patches of bog, treeless, and almost uninhabited; (2) *Dartmoor*, a wild and very extensive table-land, the surface is barren, but under it are minerals of great richness; and (3) a broad plain of pasture-land lying between (1) and (2), which forms some of the richest farming-ground in England. The industrial pursuits are mining, agriculture, ship-building at the various seaports, cider-making.
Cumberland has a mountainous surface, with fine valleys between the hills. It contains the chief heights of the Cumbrian mountains, and a number of beautiful lakes presenting the finest scenery in England. There are only three rivers of any importance. The climate being extremely moist, agriculture is chiefly confined to stock-breeding, though green crops are grown to great perfection. There is also coal and iron mining, and Borrowdale has a rich plumbago mine.
Aberdeenshire is mountainous in the S.W. the rest being level or undulating. There are four considerable rivers in the county. Although only one-third of the surface is arable, it is under the most skilful cultivation, and more fat cattle are reared than in any other county of Scotland. There are many granite quarries, and large quantities of the beautiful stone are shipped to London. The rivers are famed for their salmon fisheries.

Music.



3. Five tones and two semitones, the latter being found between the 3rd and 4th, and 7th and 8th notes.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Reduce, add together, and state total of the following five quantities:—£6⅜, £19⅛, £21⅓, £5·75, £14·125.
2. What is the cost of 5¼ oz. of gold when 1¼ oz. are worth £6½?
3. Reduce 3/4 of a guinea to the decimal of £.
4. By what decimal is 1/8 greater, or less, than the product of ·00756122 × 77·482?
5. Divide the sum of £4 5s. 8d. between two people, so that one may have three times as much as the other.

FEMALES.

1. If a gentleman's income be £500 a year, and he spend 19s. 4d. a day, how much will he have saved at the year's end?
2. If I pay 10 shillings for the carriage of 2 tons for 6 miles, what must I pay for the carriage of 12 tons 17 cwt. for 17 miles?
3. A gentleman bought a wedge of gold, which weighed 14 lbs. 3 ozs. 8 dwt., for the sum of £514 4s.; at what rate did he pay for it per ounce?
4. How many allowances of 5 oz. 7 drs. each may be cut from seven cheeses, each weighing 1 cwt. 2 qrs. 5 lbs.?

Grammar.

1. Parse each word in the following:—
   (*a*.) Yours faithfully.
   (*b*.) 'Sweet lord, you play me false.'
   (*c*.) 'Far from the madding crowd's ignoble strife.'
2. What is meant by interrogative adverbs? Give examples.
3. The suffix *ly* forms certain words into adverbs, others into adjectives: give examples.

Geography.

1. Draw a full map of France. Insert the lines of latitude and longitude.
2. Trace minutely the course of the Rhine, mentioning in order its tributaries and the towns on its banks, and describing the character of the country through which it flows.

History.

1. Write down a list of our sovereigns from Alfred to Edgar, with dates.
2. What sovereigns reigned between Henry I. and Richard II.? Give their dates.
3. Mention the names and dates of sovereigns who sat on the throne between 1660 and 1760.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Geraldine*.

Write, in small hand, as a specimen of copy-setting, *The Programme of Proceedings*.

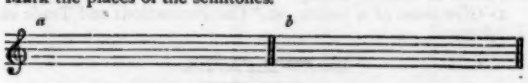
Composition.

Write from memory the substance of the passage read to you by the Inspector.

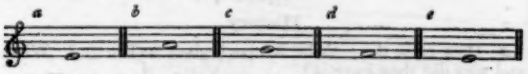
Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of D (*Re*), and in *b* the scale of B♭ (*Se*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.



2. Place its third below *a*, its fifth below *b*, its fourth above *c*, its fifth above *d*, and its octave below *e*.



3. How many semiquavers are equal (in length) to one semibreve?
How many quavers are equal (in length) to one minim?
How many crotchets are equal (in length) to one dotted minim?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1.

	£	s.	d.
£6½	= 6	7	6
£19⅘	= 19	16	8
£21¼	= 21	6	8
£5·75 = £5¾	= 5	15	0
£14·125 = £14⅛	= 14	2	6
	67	8	4 Ans.

2. 1⅛ oz. cost £6½
1 oz. „ £6½ ÷ 1⅛
∴ 5⅞ oz. „ £6½ × 4/7 × 8/9
i.e., £1 44/63 = £22 15s. 3⅓d. Ans.

3. 3/20 gui. / £1 = 3 × 21 / 14 × 20 s. = 3/20 = ·225. Ans.

4. (*a*) 11/49 = 6·3/11 = ·57

(*b*)
·00756 122
77·482
1512 244
60489 76
302448 8
5292854
5292854
·585858448 04

(*a*) = ·5757575757575...

∴ (*a*) is less than (*b*) by ·0101008722824 Ans.

5. In this sum the one gets one share and the other three shares; or £4 5s. 8d. is to be divided into four parts, one of which parts goes to one, and three to the other.

¼ of £4 5s. 8d. = £1 1s. 5d.
∴ ¾ „ „ = £3 4s. 3d. Ans.

FEMALES.

1. £365 − 365 times 8d. = £365 − £12 3s. 4d.
= £352 16s. 8d. of expenditure.
∴ £500 − £352 16s. 8d. = £147 3s. 4d. Ans.

2. 40 cwt. : 257 cwt. } :: 10s. : price of carriage.
6 mls. : 17 mls. }
10s. × 257 × 17 / 40 × 6 = £4369/480 = £9 2s. 0½d. Ans.

3. 14 lbs. 3⅛ oz. = 171½ oz.
∴ the price of 1 oz. = £514 4s. ÷ 857/2
5
857) 2571 0 (£3 Ans.
2571

4. 1 cwt. 2 qrs. 5 lbs. × 7 = 310,016 drams.
5 oz. 7 drs. = 87 „
87)310016(3563 Allowances.
261
490
435
551
522
296
261
35 drs. = 2 ozs. 3 drs. Remaining.

Grammar.

1. (*a*) *Yours*—simple personal pro. 2nd pers. mas. or fem. plur. poss. used predicatively (of *servant?*).
faithfully—adverb of manner, modifying the assertion '*I am* yours.'
(*b*) *Sweet*—qual. adj. limiting *lord*.
lord—com. noun, mas. sing. nom. of address, or vocative.
you—simple pers. pron. 2nd pers. sing. in meaning, plural form, nom. subj. of *play*.
play—intrans. verb, reg. indic. pres. indef. 2nd pers. plur. agr. with *you*.
me—simple pers. pron. 3rd pers. sing. mas. or fem. obj. gov. by (*with*).
false—adv. of manner, modif. *play*.
(*c*) *Far*—adv. of deg. modif. the phrase '*from the madding*,' *etc.*
from—prep. gov. obj. case *strife*.
the—def. art. or disting. adj. limiting *crowd*.
madding—qual. adj. limiting *crowd*.
crowd's—com. collective noun. neut. sing. poss. attrib. *strife*.
strife—abstr. noun, neut. sing. obj. gov. *from*.

2. Interrogative adverbs are those used in asking questions, and which at the same time modify the verb, as—*how*, interrogative of *manner*; *where*, of place; *when*, of *time*; *why*, of *cause*.

3. (*a*) The suffix *ly* forms adverbs (1) from *nouns*—day, dai*ly*; hour-*ly*, week-*ly* (2) from *adjectives*:—wise-*ly*, strong-*ly*; (3) from *participles*.—knowing-*ly*, loving-*ly*.

(*b*) Adjectives are formed from *nouns*—man-*ly*, month-*ly*, heaven-*ly*, ghost-*ly*.

Geography.

1. The Rhine has its main source in Mt. St. Gothard, passes through the magnificent ravine of the Rheinwald, unites with a second head-stream, and flows through a beautiful valley to Lake Constance. After leaving this lake it forms the celebrated falls of *Schaffhausen*, and winding between lofty rocks is joined by the *Aar* and reaches *Basle*. At this town the river turns north, flowing through a rich open valley, and before it reaches Mentz it is joined by the *Neckar* from the Black Forest, and the *Mayne* from the Fichtelberg in the N.E. of Bavaria. After leaving Mentz it flows west for a short distance through an unbroken succession of picturesque scenery, and then turns N.W. until it enters the flats of Holland. Before this, however, it is joined by the *Moselle* from the Vosges Mts. on the left, and by the *Lahn*, *Ruhr*, and *Lippe*. Entering Holland, it immediately divides into two branches, the southern and larger called the *Waal*, which flows west, and joins the *Maas*; whilst the other, called the Rign (Rhine) flows N.W., and after dividing into several other branches, falls into the North Sea below *Leyden*. Just after entering Holland the Rhine throws off a branch called the *Yssel*, which falls into the Zuyder Zee; and half-way between Utrecht and Leyden the *Amstel* leaves the main stream, and flows into the estuary called the Y. The delta of the Rhine is the largest in Europe, and the length of the river is at least 800 miles. The towns on the main stream in order are:—*Constance, Basle, Strasbourg, Carlsruhe, Spires, Mannheim, Worms-Mentz, Coblentz, Bonn, Cologne, Nimeguen (Waal), Zutphen, (Yssel), Rotterdam, Utrecht, Amsterdam (Amstel)*.

History.

				A.D.
1.	Alfred	began to	reign	871
	Edward (the Elder)	,,	,,	901
	Athelstan	,,	,,	925
	Edmund	,,	,,	941
	Edred	,,	,,	946
	Edwy	,,	,,	955
	Edgar	,,	,,	958

2. The sovereigns between Henry I. and Richard II. were—

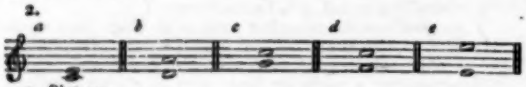
			A.D.
Stephen	who began to	reign	1135
Henry II.	,,	,,	1154
Richard I.	,,	,,	1189
John	,,	,,	1199
Henry III.	,,	,,	1216
Edward I.	,,	,,	1272
Edward II.	,,	,,	1307
Edward III.	,,	,,	1327

				A.D.
3.	Charles II.	began to	reign	1660
	James II.	,,	,,	1685—dethroned 1688
	William III. / Mary II.	,,	,,	1689
	Anne	,,	,,	1702
	George I.	,,	,,	1714
	George II.	,,	,,	1727
	George III.	,,	,,	1760

Music.

1.

2.



3. Sixteen.
Four.
Three.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Sixty-nine rifle competitors fired 30 shots apiece, and each man made an average of $1\frac{1}{2}$ centres. What was the percentage of centres to shots?

2. Find the interest on £527 11s. 9d. for $7\frac{1}{2}$ years at $3\frac{1}{10}$ per cent. per annum.

3. By selling eggs at 3 a penny I gain 5 per cent. What do I gain or lose per cent. by selling them at the rate of 25 for 6d.?

4. Divide £723 15s. among A, B, C, D, so that A, B, and C shall receive equal shares, and D $\frac{1}{4}$ of one of their shares.

5. Bought 236 yds. of lace at 7s. $10\frac{1}{2}$d. per yd.; sold $\frac{1}{4}$ of it at 10s. 6d. per yd., $\frac{1}{3}$ at 8s. 6d. per yd., and the remainder at 7s. per yd. What was the gain or loss per cent. on the whole outlay?

FEMALES.

1. Divide $9\frac{1}{2}$ by $\frac{1}{2}$ of 7; and 5205$\frac{1}{4}$ by $\frac{1}{4}$ of 91.

2. If 25$\frac{1}{2}$s. will pay for the carriage of 1 cwt. for 145$\frac{1}{2}$ miles, how far may $6\frac{1}{4}$ cwt. be carried for the same money?

3. If £50 in 5 months gain £$2\frac{2}{17}$, what time will £$13\frac{1}{3}$ require to gain £$1\frac{1}{17}$?

4. Reduce 9 oz. $2\frac{1}{2}$ drs. to the fraction of a pound avoirdupois.

Grammar.

1. Point out and parse all the pronouns and prepositions in the following:—

'And never yet, since high in Paradise
O'er the four rivers the first roses blew,
Came purer pleasure into mortal kind
Than lived thro' her who in that perilous hour
Put hand to hand beneath her husband's heart
And felt him *hers* again.'

(*a*) What are the analogous forms to 'hers,' derived from *thou, you, they?* and how does the use of these forms (hers, etc., etc.) differ from that of *her, thy, your, their?*

(*b*) Point out the principal sentence in the above, and analyse it.

2. Explain the terms—Syntax, subject, predicate, complex sentence, subordinate sentence.

Geography.

1. Draw a full map of our possessions in South Africa. Insert the lines of latitude and longitude, and explain how they are useful in drawing a map.

2. Give notes of a lesson on 'The Productions and Trade of Hindostan.'

SECOND PAPER.

One hour allowed for Females, two hours and a half allowed for Males.

History.

1. How came there to be Roman legions in Britain? When and why did they leave it?

2. What was Danegeld? Tell its object and effect.

3. In what way did Edward III. and Henry IV. respectively obtain the throne?

Penmanship.

Write in large hand, as a specimen of copy-setting, the word *Geraldine.*

Write in small hand, as a specimen of copy-setting, *The Programme of Proceedings.*

Composition.

Write full notes of a lesson on 'Malt and Hops.'

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. The angles at the base of an isosceles triangle are equal to each other, and if the equal sides be produced the angles on the other side of the base shall be equal.

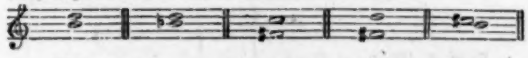
2. To bisect a given finite straight line—that is, to divide it into two equal parts.

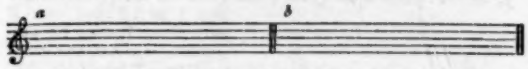
3. Describe a circle which shall pass through two given points, and have its centre in a given straight line. Is this always possible?

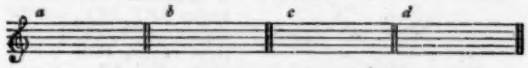
Music.

A quarter of an hour allowed for this paper.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms:—



2. Write in *a* two measures of common time, and in *b* two measures of triple time. Place the time signature before each.

3. Write in *a* the signature of G (*Sol*), in *b* that of F (*Fa*), in *c* that of E (*Mi*), and in *d* that of E♭ (*Me*).



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. 69 times 30 shots = 2070 shots.
69 times $1\frac{1}{2}$ centres = 92 centres.
2070 shots give 92 centres.
∴ 100 ,, ,, $92 \times \frac{100}{2070}$.
i.e., $\frac{920}{207} = 4\frac{44}{207}$ p.c. Ans.

2. Interest = £ s. d. 527 11 9 $\times 7\frac{1}{2} \times \frac{3\frac{1}{16}}{100}$

			$7\frac{1}{2}$
	263	15	$10\frac{1}{2}$
	3693	2	3
	3956	18	$1\frac{1}{2}$
			$3\frac{1}{16}$
	395	13	$9\frac{3}{4}$
	11870	14	$4\frac{1}{4}$
	122.66	8	2·25
	20		
	13·28		
	12		
	3·3825		

∴ Interest = £122 13s. 3·3825d. Ans.

3. The price of 1 when 3 cost 1d. = $\frac{1}{3}$d.
,, ,, 1 ,, 25 ,, 6d. = $\frac{6}{25}$d.
∴ selling the article at $\frac{1}{3}$d. brought $\frac{100}{75\frac{1}{2}}$ of prime cost.

,,	1d.	,,	$\frac{300}{75\frac{1}{2}}$	,,
,,	$\frac{1}{25}$d.	,,	$\frac{12\frac{1}{2}}{100}$	,,
,,	$\frac{6}{25}$d.	,,	$\frac{75\frac{1}{2}}{100}$	,,

i.e., a loss of $24\frac{1}{2}$ p.c. Ans.

4. A, B, C, and D get a total of $3\frac{1}{8}$ parts of £723 15s.

	£	s.	d.
A, B, or C's share = 723 15 0 ÷ $3\frac{1}{8}$ =	3618	15	0
		6 × 3	
,, =	603	2	6
		3	
,, =	201	0	10
∴ D's share $\frac{1}{8}$ of £201 1s. 3d =	£120	12	6

5.

		£	s.	d.
$\frac{1}{4}$ of 236 yds. = 59	at 10s. 6d. =	30	19	6
$\frac{1}{3}$,, = $78\frac{2}{3}$	,, 8s. 6d. =	33	8	8
And ∴ the remainder = $98\frac{1}{3}$	,, 7s. 0d. =	34	8	4
	Total =	98	16	6
236 at 7s. 10½d. =		92	18	6
∴ there is a gain		5	18	0

£92 18s. 6d. brings a gain of £5 18s.
∴ £100 ,, £5 18s. × 100
£92 $18\frac{1}{2}$s.
i.e., £$\frac{5925}{371}$ = £6 $\frac{134}{371}$ p.c. Ans.

FEMALES.

1. (*a*) $9\frac{1}{2} \div \frac{1}{2}$ of $7 = \frac{19}{2} \times \frac{2}{7} = \underline{2\frac{5}{7}}$
(*b*) $5205\frac{1}{2} \div \frac{1}{8}$ of $91 = \frac{2\,0\,8\,2\,2}{2} \times \frac{8}{91} = \frac{1\,3\,0\,5\,5\,2}{1\,8\,2} = \underline{71\frac{1}{2}}$

2. 1 cwt. is carried $145\frac{1}{2}$ mls. for $25\frac{3}{4}$s.
∴ $6\frac{1}{2}$,, ,, $\frac{145\frac{1}{2}}{6\frac{1}{2}}$,, ,,
i.e., $\frac{5\,8\,3}{2\,6}$ mls. = $\underline{22\frac{5}{26}}$ mls. Ans.

3. £$13\frac{1}{2}$: £50 } :: 5 mos. : time required.
£$2\frac{27}{144}$: £$1\frac{1}{12}$ }
$\frac{5 \text{ mos.} \times 150 \times 156}{40 \times 325} = \underline{9}$ mos. Ans.

4. $\frac{9 \text{ oz. } 2\frac{3}{4} \text{ drs.}}{1 \text{ lb.}} = \frac{146\frac{3}{4} \text{ drs.}}{256 \text{ drs.}} = \frac{1\,4\,7}{2\,5\,6} = \underline{\frac{1}{2}}$ Ans.

Grammar.

1. *In*—prep. gov. obj. case *Paradise.*
o'er— ,, ,, ,, *rivers.*
into— ,, ,, ,, *kind.*
thro'— ,, ,, ,, *her.*
her—personal pron. 3rd pers. sing. fem. obj. gov. by *thro'.*
who—simple rel. pron. referring to *her.* 3rd pers. sing. fem. nom. subj. of *put.*
in—prep. gov. obj. case *hour.*
to— ,, ,, ,, *hand.*
beneath—prep. gov. obj. case *heart.*
her—pronominal poss. adj. limiting *husband.*
him—pers. pron. 3rd pers. sing. mas. obj. gov. by *felt.*
hers—pers. pron. 3rd pers. sing. fem. poss. case. used predicatively of *husband.*

(*a*) The forms of *thou*, *you*, and *they*, analogous to '*hers*,' are *thine*, *yours*, and *theirs*. These forms differ from *thy*, *your*, and *their* (which are used attributively), in being used without an expressed noun and only in the predicate of the sentence. *Thin* is sometimes used in poetry for *thy* before a word beginning with a vowel.

(*b*) The principal sentence is 'and never yet came purer pleasure into mortal kind.'

Pleasure	simple subject.
purer	enlargement of subject.
came	incomplete predicate.
into mortal kind	completion of pred.
never yet	extension of pred. (*time*).

2. *Syntax* (*syn*, together, *taxis* arrangement) is the proper arrangement and connection of words in a sentence.

The *subject* denotes that which we speak about, and is always in the nominative to some verb.

The *predicate* is that which denotes what is said about the subject.

Complex, when applied to a sentence means that the sentence is one which, besides a principal subject and predicate, contains one or more subordinate clauses which have subjects and predicates of their own.

A *sentence* is a collection of words so arranged as to make complete sense.

A *subordinate sentence* forms a dependent part of a principal sentence, just as if it were an ordinary substantive, adjective, or adverb.

Geography.

1. The lines of latitude and longitude are useful in fixing the positions of places exactly as they are on the earth itself. They form, in fact, a complete set of guiding lines for drawing a correct representation of parts of the earth.

2. Notes on the 'Productions and Trade of Hindostan.'

PRODUCTIONS (*a*) *Vegetation*—of forest trees, teak used for ship-building, rivals the oak—of fruit trees, the various species of palms—rice, forming staple article of food is the chief grain cultivated—but wheat, barley, millet and maize also raised—besides sugar-cane, mulberry-tree, cotton, indigo, pepper—tea plant, which grows wild in Assam, has lately been carefully attended to—that valuable plant 'Cinchona' is successfully grown in the high-grounds—and opium, of which the government has a monopoly, grows chiefly in Bengal.

(*b*) *Animals*—the buffalo, camel, and elephant, are domesticated—Hindoo cattle have a hunch on the shoulders, and sheep have hair instead of wool—the cashmere goat, noted for its fine wool, the silkworm, and lac insect are largely reared—of wild animals, the leopard is frequently hunted—the lion, seen only among the northern mountains—the Bengal tiger, and the rhinoceros, are noteworthy.

(*c*) *Minerals* comprise iron, copper, tin, gold, and coal. Diamonds are found in several districts, the most valuable being those of Orissa and Golconda.

TRADE very extensively carried on with Britain, China, Japan, France, and Australasia—opium exported to China and Japan—indigo, silk, and tea to France and Great Britain—silk and saltpetre to America— principal part of exports is conveyed to the United Kingdom—one-half of all imports comes from United Kingdom—these consist chiefly of cotton goods and yarn, railway materials, and various metals—opium exchanged with China for tea and silk, which are then sent to England—thus Britain is implicated in this diabolical traffic—internal trade has been vastly developed by means of railways and canals.

History.

1. Julius Cæsar having conquered Gaul was led either from curiosity or ambition to invade Britain, B.C. 55, with two legions, and again in 54, with five legions. Cæsar having forced the Britons to yield, left the island, and not till A.D. 43, did Roman legions again visit Britain. From that year till 78, the Romans could not make head against the islanders, but the arrival of Julius Agricola led to the subjugation and partial civilisation of the Britons (78-85). In A.D. 410, under the Emperor Honorius, the attacks of barbarians on Italy led to the withdrawal of the Roman legions from Britain for the defence of the empire.

2. Soon after the accession of Ethelred, the Unready, the Danes renewed their attacks, and he very foolishly *bought* them off instead of fighting them. This led to the imposition of a tax called *Danegeld* (Dane-money) to pay the shoals of Danish invaders whom Ethelred's shameful policy attracted to the island.

3. In 1327, a parliament summoned by Queen Isabella, formally deposed Edward II., and the young prince Edward, a lad of fourteen, became king as Edward III. In the same year his father was murdered by ruffians in the pay of Isabella's paramour, Mortimer.

Henry Bolingbroke, son of John of Gaunt, Duke of Lancaster, was banished by Richard II., and during his banishment his father died. The Duke's estates were confiscated, and Henry, taking advantage of the king's absence in Ireland, came over with a number of followers to claim his inheritance. The people flocked to Henry, Richard was formally deposed for misgovernment, and Bolingbroke was declared king by the title of Henry IV. (1399).

Composition.

NOTES OF A LESSON ON MALT AND HOPS.

MALT.—*Definition.*—Malt is grain, usually barley, which has become sweet and more soluble in water from the conversion of its starch into sugar, by forcing the grain to germinate or sprout to a certain extent and then stopping the process by the application of heat.

Malting—barley steeped in cold water for at least forty hours—grain imbibes moisture and increases in bulk—carbonic acid emitted—part of grain dissolved in water which is exceedingly bitter.

Water drained off and grain turned out to *malt floor* and formed into a heap called a *couch*—remains thus for twenty-six hours—turned repeatedly every twelve hours or so, and gradually spread out to a depth of six inches—in *couch*, it imbibes oxygen from atmosphere, and converts it into carbonic acid—at this time grain again becomes moist—sends out an agreeable odour—at this moistening (called *sweating*) roots begin to appear—then in a day or so the future stem, *acrospire*, is seen to lengthen—now mealy part of grain undergoes a considerable change—the glutinous matter is taken up—the colour of the kernel becomes white, and texture so loose as to crumble to powder between the fingers—the object of malting is to produce this change—when accomplished, the process is stopped by drying the malt upon the kiln—malt subsequently cleared to separate the rootlets—from malt are brewed and distilled spirits, ale, porter.

HOPS.—Climbing plants extensively cultivated for their flowers or seed-vessels, which give flavour and permanence to beer, by being boiled with the wort in brewing.

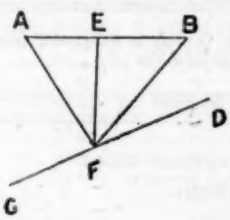
Where grown.—Most extensive plantations in Kent, Sussex, and Herefordshire—also in Worcestershire, Wilts, Hants, Gloucestershire, Surrey—those of Kent and Sussex, the best in the world.

Cultivation.—Requires a very rich soil—young plants raised in beds, sometimes from seed, more usually from shoots got at bottom of stems of old plants—young plants placed in groups of three, about six inches apart—when *bines* appear a stick three or four feet is stuck in the middle of the three, and the bines tied till they lay hold on and twine round it—generally there are no hops got the first year—in second year plants carefully examined and staked with poles twelve feet long—in September the flower containing the seed assumes a fine straw colour turning to a brown—picking then commences—hops dried on hair-cloth in a kiln—undergo a slight heating in heaps—and then bagged and stored till wanted for sale.

Uses.—Besides flavouring beer they are used in medicine—brown dye got from leaves—the bines have been made into paper and cloth—prunings useful as provender for cattle—spent hops may be used as a manure.

Euclid.

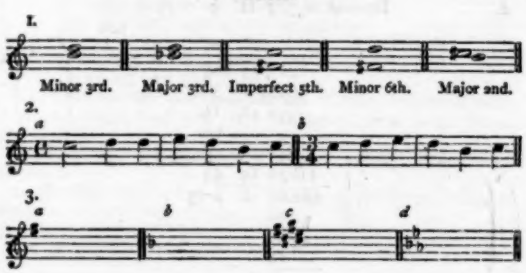
1. Prop. 5, Bk. 1.
2. Prop. 10, Bk. 1.
3. Let A and B be the given points, and CD the given straight line. Join AB, and bisect it in E. From E draw EF perpendicular to AB, and meeting CD in F. Join AF, BF.



Because AE=EB and EF is common to the two triangles AEF, BEF, and the angles AEF, BEF, are right angles, then (by I. 4) the base AF=BF, and ∴ the circle described from the centre F at the distance FA, or FB, will pass through the points A and B. Q.E.F.

This problem is impossible when the line joining the two given points is perpendicular to the given line, because in such a case the perpendicular from the point of bisection could not meet the given line.

Music.



THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a-half allowed.

Arithmetic.

MALES.

1. A boy earns 18s. a week, spends only 14s. 6d., gives his mother ⅔ of his savings to put by for him, and the remainder for her own use. What percentage of his income does he put by; and what percentage goes to his mother for her own use?

2. If £33 6s. 8d. produce £5 8s. 6⅔d. in 1¼ years, what sum may be expected from £520 17s. 11d. dealt with in the same way for 2¼ years, and what is the rate per cent. per annum of profit?

3. I bought 15 gallons of a liqueur for £27, and retailed it at 5s. a pint; what was the gain per cent., and what on the whole?

4. What income will be derived from shares paying 7 per cent. purchased (at par) with the sum accruing from the sale of £629 14s. 5d. of stock at 92¾ per cent.?

5. A has 50 chests of tea, which cost £22 10s. per chest; he barters with B, at an estimated profit of 20 per cent., for a quantity of mahogany at £30 a ton. The mahogany depreciating in value during storage, A loses on it 1s. 6d. per cwt. What is his net gain by the transaction?

FEMALES.

1. If ·375 of a ship be worth £3740; what is the worth of the whole?
2. From 270·2 take 76·4075, and divide 721·17562 by 2·257432.
3. Reduce 2 gal. 1 qt. beer to the dec. of a barrel, and find the value of ·046875 of a lb. avoirdupois.
4. Divide $3\cdot\frac{5}{}$ by ·24, and multiply $4\cdot7\frac{2}{}$ by 3·6,

Grammar.

1. 'It is great sin to swear unto a sin,
But greater sin to keep a sinful oath.
Who can be bound by any solemn vow
To do a murderous deed, to rob a man,
To reave the orphan of his patrimony,
And have no other reason for this wrong
But that he was bound by a solemn oath?'
—KING HENRY VI.

(*a*.) Parse all the words in the last line.
(*b*.) Analyse the two sentences contained in the last two lines, supplying any words that are required to make the analysis complete.
N.B. Take care to point out the character of each sentence.
(*c*.) When is the infinitive mood used without being preceded by the word *to*? Give examples of this from the above passage, and mention others that occur to you.
2. Write the subject-matter of a lesson on either of the following:—Mood, Tense.
3. Give the Latin prepositions that mean under, with, across, out of.

Geography.

1. Draw a full map of our possessions in South Africa. Insert the lines of latitude and longitude, and explain how they are useful in drawing a map.
2. Give notes of a lesson on 'The Caspian Sea.'

SECOND PAPER

One hour allowed for Females
Two hours and a-half allowed for Males.

History.

1. Give the names and dates of sovereigns of the House of Tudor and show the relationship between them.
2. Do you consider our Stuart sovereigns to have been fortunate or unfortunate? Give your reasons.
3. During the reign of George III. a large foreign possession was lost to England. Explain the event and give some particulars.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Geraldine*.
Write, in small hand, as a specimen of copy-setting, *The Programme of Proceedings*.

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used]
1. If two triangles have two sides of the one equal to two sides of the other, each to each, but the base of one greater than the base of the other; the angle contained by the sides of the one which has the greater base shall be greater than the angle contained by the sides, equal to them, of the other.
2. The opposite sides and angles of a parallelogram are equal to one another and the diameter bisects it, that is, divides it into two equal parts.
3. If in the sides of a square, at equal distances from the four angles, four points be taken, one in each side, the figure formed by joining them will also be a square.

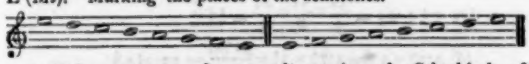
Algebra.

1. Explain the terms *coefficient, expression, factor, index, greatest common measure, identical equation.*
Find the coefficiency of x^3 in the product of ax^4-bx^3+cx-d and fx^3-gx+r.
2. Reduce $\frac{x^2-5x+6}{x^2+2x-8}$ and $\frac{6+x-x^2}{8+6x+x^2}$ to lowest terms, and then add them together.
3. Solve the equations:—
(1.) $\frac{1}{2}(x-\frac{1}{4})-\frac{1}{3}(\frac{1}{2}-x)=1\frac{1}{12}$.
(2.) $\frac{7x+1}{x-1}=\frac{4}{9}\left(\frac{x+4}{x+2}\right)+\frac{5}{9}$.

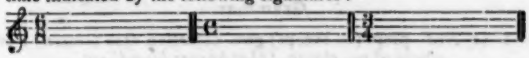
Music.

A quarter of an hour allowed for this paper.

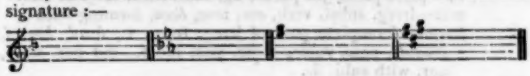
1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of E (*Mi*). Marking the places of the semitones.



2. Write a measure, of notes and rests, in each of the kinds of time indicated by the following signatures:—



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature:—



ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. (*a*) $\frac{3}{4}$ of (18s. — 14s. 6d.) = 3s. 6d. × $\frac{4}{7}$ = 1s. 6d. put by.
(*b*) ∴ he gives 2s. to his mother for her own use.
(*a*) 1s. 6d. = $\frac{1}{12}$ of 18s., *i.e.*, $\frac{100}{12}$ or $8\frac{1}{3}$ p. c. of whole.
(*b*) 2s. od. = $\frac{2}{9}$ of 18s., ,, $\frac{100}{9}$,, $11\frac{1}{9}$,, ,,

2. (*a*)
£33 6s. 8d. : £520 17s. 11d.
or
8,000d. : 125,015d. } :: £5 8s. 6$\frac{3}{4}$d.
or
1$\frac{1}{2}$ yr. : 2$\frac{1}{2}$ yrs. } :: $\frac{20023}{4}$d. : Int.
$\frac{8003}{4}$d. × $\frac{125015}{8000}$ × $\frac{2}{3}$ = 36641·896 d. =
£152 13s. 5·8965d.

(*b*) £33$\frac{1}{3}$: £100 :: £5 8s. 6$\frac{3}{4}$d. : rate p. c.
1$\frac{1}{2}$ yr. : 1 yr.
$\frac{£16\ 5s.\ 8d.}{3}$ × $\frac{200}{150}$ × $\frac{1}{5}$ = $\frac{£65\ 2s.\ 8d.}{5}$ =
£13 os. 6$\frac{4}{5}$d. Ans.

3. 15 galls. @ 5s. a pt. = 5s. × 120 = £30
Cost price = £27
(*a*) ∴ Gain on whole = £3
(*b*) Prime cost £27 brings a profit of £3
,, £100 ,, ,, £3 × $\frac{100}{27}$
i.e. 11$\frac{1}{9}$ p. c. Ans.

4. (*a*) Sum accruing from sale of stock = £629 14s. 5d. × $\frac{92\frac{3}{4}}{100}$

(*b*) ∴ Income = £629 14s. 5d. × $\frac{92\frac{3}{4}}{100}$ × $\frac{7}{100}$
= 151133d. × $\frac{739}{800}$ × $\frac{7}{100}$
= $\frac{78181\cdot1009}{8}$ d.
= 9772·6376125d.
i.e. = £40 14s. 4·6376125d. Ans.

5. 50 chests at £22 10s. = £22$\frac{1}{2}$ × 50 = £1125
$\frac{20}{100}$ of £1,125 = £225
∴ the value of the mahogany = 1350
and weight ,, = $\frac{1350}{30}$ = 45 tons
Loss on 45 tons at 1s. 6d. per cwt. = 1$\frac{1}{2}$ × 900 = 1350s. = £67 10s.;
And so A.'s net gain = (£225 − £67 10s.) = £157 10s. Ans.

FEMALES.

1. ·375 = $\frac{375}{1000}$ or $\frac{3}{8}$; ∴ the value of whole ship = $\frac{£3740\times8}{3}$ = £$\frac{29920}{3}$ = £9972 6s. 8d. Ans.

(*a*)

2. 270·2
76·4075
193·7925

(*b*)

2·257432)721·17562(319·46.....
677 2296
4394602
2257432
21371700
20316888
10548120
9029728
.....

3. (*a*) $\frac{2 \text{ galls. } 1 \text{ qt.}}{36 \text{ galls.}} = \frac{9 \text{ qts.}}{144} = \frac{\cdot 75}{12} = \underline{\cdot 0625}$

(*b*) ·046875 lbs. = ·75 oz. = 12 drs.

4. (*a*) $3\cdot 5 \div \cdot 24 = \frac{32}{9} \times \frac{33}{8} = \frac{44}{3} = \underline{14\cdot 6}$

(*b*) $4\cdot 72 \times 3\cdot 6 = 4\cdot 72 \times 3\frac{1}{5} = \frac{51\cdot 94}{3} = \underline{17\cdot 3148}$

Grammar.

1. (*a*) *But*—prep. (= except) gov. objective case (*reason*); or whole of no. clause, '*that he was bound*,' etc.
that—final conj. introducing noun clause.
he—pers. pron. 3rd pers. sing. mas. nom. subj. of *was*.
was—irreg. subst. verb, *am, was, been*, forming with
bound—(complete part of irreg. trans. v., *bind, bound, bound*), pass. voice, indic. past indef., 3rd per. sing., agr. with subj. *he*.
by—prep. gov. obj. case *oath*, (connecting the notions of *binding* and *oath*).
a—indef. article, or adj. limiting *oath*.
solemn—qual. adj. limiting *oath*.
oath—abstr. noun, neut., sing., obj., gov. by *by*.

(*b*)

Sentences.	Kind.	Subject.	Predicate.	Completion of predicate.	Connective.
(1) 'And (*Who can*) have no other reason for this wrong but (*this reason*).'	Principal	(*who*)	(*can*) have	no other reason (object) for it but (*this reason*)	And
(2) 'That he was bound by a solemn oath.'	Subord. noun; in apposition with (*reason*)	he	was bound	by a solemn oath	that

(*c*) The infinitive mood without the word *to* is used after the auxiliaries *may, do, can, must, shall, will*, and after these principal verbs *bid, make, see, hear, let, full, need, dare* (intrans.), *will*.

(*a*) Examples from given passages (1), 'Who can (*to*) *be bound*' (2) (*who can*) (*to*) *have* no other reason.

(*b*) Other examples: 'Men *may come*, and men *may go*;' '*I dare do* all that *may become* a man;' '*Bid me* discourse, I will *enchant* thy ear;' 'Need we *fear* discovery.'

2. (1) MOOD (*modus*, manner) is that inflexion which a verb undergoes to show the *mode* or manner in which the action or state denoted by the verb is presented to our minds. (2) When we make a direct assertion, or ask a question, we use the *Indicative* (*indicare*, to point out) Mood. (3) When we order anything to be done, we use the Imperative (*imperare*, to command). (4) When we wish to express a conditional or uncertain statement, we use the Subjunctive (*subjungere*, to subjoin); and (5) when the notion expressed by the verb is used without any reference to an agent, we employ the Infinitive (*infinitus*, unbounded) Mood.

Examples of all the Moods to be given orally, derived from the pupils, written on blackboard, and searched for in reading books. Examples always to precede definitions.

TENSE (*tempus*, time) is that form of the verb which indicates the *time* of the action or state, and the *completeness*, or incompleteness of that action or state.

Time consists of three divisions, *Past*, *Present*, and *Future*, and as these may be either perfect, imperfect, or indefinite; from these three spring *nine* kinds of tense:—

Present { Perfect—*I have written, I have been told.*
Imperfect—*I am writing, I am being told.*
Indefinite—*I write, I am told.*

Past. { Perfect—*I had written, I had been told.*
Imperfect—*I was writing, I was being told.*
Indefinite—*I wrote, I was told.*

Future. { Perfect—*I shall have written, I shall have been told.*
Imperfect—*I shall be writing, I shall be beingtold.*
Indefinite—*I shall write, I shall be told.*

3. The Latin preposition for *under* is sub or subs (suc—suf—sur—sus—so—*as in sojourn*)
'*with*' is cum (con—com—col—cor—co)
'*across*' is trans or tra
'*out of*' is ex (ec—ef—e—)

Geography.

1. *See same question answered under Geography of 'Second Year.'*

2. Notes on the 'CASPIAN SEA.'

Position—Lies on south-eastern boundary of Europe—Caucasia on western—Persia on southern shore—Russia on north and east.

Character—a vast salt-water lake—largest strictly inland expanse of water in the world—called a 'sea' by the ancients who thought it a part of the Northern Ocean—remarkable from its surface being below the general level of the waters of the globe, and having no outlet.

Extent—640 miles long—from 100 to 200 miles broad—covers an area of from 130,000 to 180,000 sq. miles.

Feeders—principal rivers running into it—the *Volga*, (2,200 miles), longest of European rivers—the *Ural* (1,150 miles), *Terek* (300 miles), *Kour* (550 miles), and the *Atrek*.

How surplus water is got rid of—supply of rain and river water seems to be exactly equal to the amount evaporated—were this not the case an alteration of level would be the result—present level remains unchanged.

Note—the Caspian Sea *has no tides*—waters are moderately salt—it is shallow—stormy—of difficult navigation—and has a few indifferent ports.

History.

1. The following list shows the Tudor dynasty with the relation of the successor to the immediate predecessor:—

Henry VII.	first of the House of Tudor,			1485—1509
Henry VIII.	(son) reigned from		...	1509—1547
Edward VI.	(son)	,,	...	1547—1553
Mary	(sister)	,,	...	1553—1558
Elizabeth	(sister)	,,	...	1558—1603.

2. The following facts connected with the history of the Stuarts shew them to have been a very unfortunate race, namely:—Charles I. was executed 1649, and his son Charles II. was a fugitive for eleven years, from 1649 to 1660. James II. was deposed 1687, and his male descendants were disinherited.

3. During the reign of George III. the American Colonies refused to pay taxes to the home Government, because they did not send representatives to Parliament. The British Government endeavoured by force of arms to compel them to yield, but the Americans, under the command of George Washington, maintained a war for seven years (1776—83), during which many battles were fought with various success. At length the capitulation of the British first at Saratoga and then at Yorktown compelled the home Government to come to terms, and the treaty was drawn up 1783, by which the independence of the United States was acknowledged.

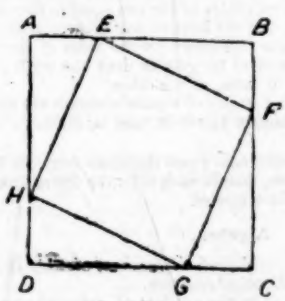
Euclid.

1. Prop. 25, Bk. I.

2. Prop. 36, Bk. I.

3. Let E, F, G, H, be points taken equally distant from A, B, C, D, the angles of the square ABCD: then the figure EFGH will be a square.

Because AE is equal to BF and AH obviously equal to BE; and the angles at A and B right angles then (by I. 4) the triangles AEH, BFE are equal in every respect. Wherefore EH is equal to EF. In the same way it may be shown that EF=FG, FG=GH, and GH=EH, and therefore the figure EFGH is equilateral.



Again the triangles AEH, BFE being equal in every respect, the angle BFE =angle AEH. ∴ the angles AEH, BEF are equal to the angles BFE, AEH. Now it is evident that

BFE, BEF being equal to a right angle (I. 32) AEH, BEF must be equal to a right angle, and therefore the remaining angle HEF being the supplement of two right angles must be a right angle. In the same manner the angles at F, G, H, are right angles, and therefore the figure EFGH is rectangular. It is therefore a square—Q.E.D.

Algebra.

1. *Co-efficient* is the number, whether whole or fractional, which is placed before a quantity as a multiplier, as 5 in $5a$, $5a$ in $5ax$. These may be both *literal* and *numerical* co-efficients.

An *Expression* is any collection of algebraical symbols. When the quantity consists of one *term* as b, bx, it is *simple*, or a monomial; of two terms, as $a+x$ it is a *binomial*; of three as, $ay+ax+by$, it is a *trinomial*; of more than three, it is a *multinomial*. When a quantity consists of the product of two or more quantities, each of the latter is called a *factor*; thus, in the expression axy there are three factors, a, x, and y.

An *Index* is a number placed above a quantity to express the power of that quantity; it is also called the *exponent*; thus, 3 is the index of a in a^3.

The *greatest common measure* of two or more quantities is the greatest number or quantity that will divide each of them without a remainder, thus ax is the G. C. M. of axy, $2abxz$, $3acx$.

An *identical equation* is one in which the one side is identical with the other, thus $ab + bx^2 = ab + bx^2$, or $(a-b)(a+b) = a^2 - b^2$. It has been advised that *three* lines should be used in place of *two* when the one expression is identically equivalent to the other, thus $(a+x)^2 \equiv a^2 + 2ax + x^2$.

$$
\begin{array}{l}
ax^4 - bx^3 + cx - d \\
px^2 - qx + r \\
\hline
apx^6 - bpx^5 + pcx^3 - pdx^2 \\
\quad - aqx^5 + bqx^4 - cqx^2 + dqx \\
\quad\quad + arx^4 - brx^3 + crx - dr \\
\hline
apx^6 - (aq+bp)x^5 + (ar+bq)x^4 + (pc-br)x^3 + (cq-pd)x^2 + (cr+dq)x - dr
\end{array}
$$

$\therefore$ the coefficiency of x^3 is $\underline{(pc-br)}$ Ans.

2. (*a*) $\dfrac{x^2-5x+6}{x^2+2x-8} = \dfrac{(x-2)(x-3)}{(x-2)(x+4)} = \dfrac{x-3}{x+4}$

(*b*) $\dfrac{6+x-x^2}{8+6x+x^2} = \dfrac{(3-x)(2+x)}{(x+4)(2+x)} = \dfrac{3-x}{x+4}$

$\therefore$ the sum of (*a*) and (*b*) $= \underline{0}$ Ans.

3. (1) $\frac{1}{2}(x-\frac{1}{2}) - \frac{1}{3}(\frac{1}{2}-x) = \frac{11}{12}$

Clearing of fractions $30x - 15 - 28 + 42x = 301$

$72x = 301 + 43 = 344$

$\therefore x = \underline{4\frac{4}{9}}$ Ans.

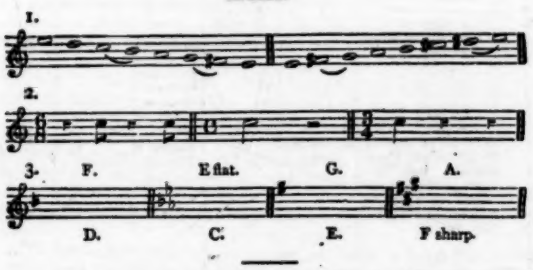
(2) $\dfrac{7x+1}{x-1} = \frac{28}{9}\left(\dfrac{x+4}{x+2}\right) + \frac{28}{9}$

$\dfrac{63+9}{x-1} = \dfrac{35x+140+28x+56}{x+2} = \dfrac{63x+196}{x+2}$

$\therefore 63x^2 + 135x + 18 = 63x^2 + 133x - 196$

$2x = -214$

$\underline{x = -107}$ Ans.

Music.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after,* 1st *May,* 1878; **and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. Sold goods for £225 10s. 0d. with a gain of 12½ per cent., how much per cent. would have been gained or lost by selling them for £187 10s. 0d.?

2. What sum must I have invested (neglecting fractions of a penny) in 3½ per cent. stock at 89¼, in order that, spending daily 15s. 6d. out of my income, I may lay by in a year (365 days) £123·55?

3. If the loss per cent. in selling 50 copies of a book at 7s. 6d. per copy, 80 at 4s., and the remainder of the edition for £12, was 35⅓ %; what was the cost of publishing the book?

4. By how much greater or less than £25 5s. 6d. will be the interest on £321·76875 for 2 years 5 months at 3½ per cent. per annum?

5. What is the length of one of the four equal sides of a rectangular park containing 98759·3476 square yards;

or, what fraction of a mile is the side of a similarly shaped park containing ·694 square mile?

FEMALES.

1. If I buy a yard of cloth for 14s. 6d. and sell it for 16s. 9d., what do I gain per cent.?

2. At what rate per cent. will £956 amount to £1314 10s. in 7½ years at simple interest?

3. A young man received £210, which was ⅔ of his elder brother's portion; now three times the elder brother's portion was half of the father's estate, how much was the estate worth?

4. Find the interest of £985 2s. 7d. for 5 years 127 days, at 5½ per cent. per annum.

Grammar.

1. '*Let it be remembered, that to write, however* ably, merely to convince *those* who are already *convinced, displays but* the courage of a boaster.' COLERIDGE. *The Friend.*

(*a*) Analyse the above passage.
(*b*) Parse fully all the words in italics.
(*c*) What is meant by a finite verb, and what is the nature of the infinitive mood? Illustrate from the above passage.

2. In what respects is the English alphabet incomplete?

Geography.

1. Give notes of a lesson to an advanced class on 'The Lines of Latitude and Longitude, as shown on a globe, their meaning and their usefulness.'

Draw a map of North America, with the lines inserted, and refer to this map at each point of the lesson.

2. What is a Coral Island? Where are such islands found?

SECOND PAPER.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. What English sovereigns have died a violent death? Distinguish between accident and design, and give dates of the events.

2. When and how did the conquest of Ireland begin, and under what circumstances was the legislative union with that country effected?

3. Mention what you consider to be the most important events which have happened so far in the reign of the Queen.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Geraldine.*

Write, in small hand, as a specimen of copy-setting, *The Programme of the Proceedings.*

Composition.

Write a short essay on *Colonization.*

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. ABCD is a parallelogram; through A draw any line, and show that the distance of C from this line is equal to the sum or difference of the distances of D and B, according as the line passes without or within the parallelogram.

2. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by the parts.

3. To describe a square that shall be equal to a given rectilineal figure.

Algebra.

1. Show that $3(y-x)(y+x)(5y^2-8xy+5x^2)=(x-2y)^4-(2x-y)^4$.

2. Find a number such that, whether it be divided into two or into three equal parts, the continued products of the parts shall be the same.

3. Solve the equations:—

(1) $\begin{cases} 10x-11y+12=0 \\ 13x-14y+11\cdot7=0. \end{cases}$

(2) $\frac{7x}{3}+\frac{3-x}{2x}=20\frac{1}{2}$.

Mensuration.

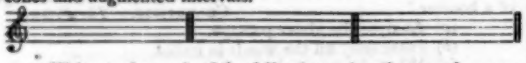
1. 'The area of a triangle is half the product of the base and the altitude.' How would you prove this to a class of boys who have read the first book of Euclid?

2. An oblong grass plot 120 feet by 60 is to be levelled at £6 1s. per square chain, and a lawn tennis court 78 feet by 36 is to be turfed within it at 4d. per square yard. What will be the cost?

Music.

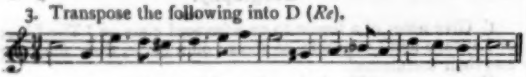
A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of E (*Mi*) minor, in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.



2. Write, under each of the following pairs of notes, the name and quality (major, perfect, diminished, or other) of the interval it forms:—

3. Transpose the following into D (*Re*).



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. What was sold at £225½ brought $\frac{112\frac{3}{4}}{100}$ of prime cost.

£1 „ $\frac{225\frac{1}{2}}{100}\div\frac{225\frac{1}{2}}{1}$ „

£187½ „ $\frac{225\frac{1}{2}}{100}\times\frac{2}{225}\times\frac{187\frac{1}{2}}{1}$ „

i.e., $\frac{37\frac{1}{2}}{100}$ „

i.e., $\frac{93\frac{3}{4}}{100}$ „

Which is ∴ a loss of $6\frac{1}{4}$ per cent. Ans.

2. 365 at 15s. 6d. = £282·875

The savings = 123·55

∴ total income must be £406·425

Now, £3½ is got from £89½

£1 „ $\frac{179}{7}\div\frac{7}{2}$

∴ £406·425 „ $\frac{179}{7}\times\frac{2}{7}\times\frac{406425}{1000}$

i.e., $\frac{14\,32\,14\,850}{49\,000}$

or £10349 6s. 5d.

3. (*a*)

	£	s.
50 copies at 7s. 6d. ea. =	18	15
80 „ 4s. 0d. „ =	16	0
And remaining sales =	12	0

∴ total price of edition = 46 15

(*b*) Now, since there was a loss of $35\frac{1}{2}$ p. c.

∴ £46½ must have brought only $\frac{64\frac{1}{2}}{100}$ of publishing price,

which price must have been $£46\frac{1}{2}\times\frac{100}{64\frac{1}{2}}=£\frac{93}{2}\times\frac{200}{129}$

$=£\frac{3\,100}{43}$

i.e., £72 10s.

4. Interest $=£321\cdot76875\times2\frac{1}{12}\times\frac{3\frac{1}{2}}{100}$

$=£\frac{321\cdot76875\times29\times13}{12\times100\times4}$

$=£\frac{1213\cdot0681875}{48}$

$=£25\cdot27225390625$

i.e., £25 5s. 5·3409375d.

and given sum is £25 5s. 6d.

∴ given sum is greater by 0·6590625d.

5. (*a*) The length of one side = $\sqrt{98759\cdot3476}$ sq. yds.

Taking square root.

98759·3476 (314·26

3×3 = 9

87

6,1×1 = 61

2659

62,4×4 = 2496

16334

628,2×2 = 12564

377076

62846×6 = 377076

∴ each side = 314·26 yards.

(*b*) .694 = $\frac{347}{500}$ = $\frac{3}{4}$ ∴ a side of park = $\sqrt{\frac{3}{4}}$ sq. ml.

i.e., the length of each side is ¾ of a mile. Ans.

FEMALES.

1. 14½s. brings a profit 2½s.

1 „ „ $\frac{2\frac{1}{2}}{14\frac{1}{2}}\div\frac{29}{2}$

∴ 100 „ „ $\frac{2\frac{1}{2}}{14\frac{1}{2}}\times\frac{2}{29}\times\frac{100}{1}$

i.e., $\frac{400}{841}$ or $15\frac{565}{841}$ per cent.

2. £1,314 10s. − £956 = £358 10s. of interest

£956 : £100 } :: £358½ : rate per cent.
7¼ yrs. : 1 yr. }

$£\frac{7}{2}\frac{7}{4}\times\frac{1}{\frac{29}{2}}\times\frac{1}{\frac{29}{4}}=£5$. Ans.

3. $\frac{2}{3}$ of £210 = elder brother's portion.

3 times ($\frac{1}{3}$ of £210) = half of father's estate.

∴ ($\frac{1}{3}$ of £210) × 3 × 2 = value of whole estate.

„ $=\frac{£210\times3\times3\times2.}{2}$

i.e., £1890. Ans.

4. Interest = £985 2s. 7d × $\frac{1952}{365}\times\frac{5\frac{1}{2}}{100}$

$=£985\frac{13}{240}\times\frac{1952}{365}\times\frac{11}{200}$

$=£\frac{236431\times1952\times11}{240\times365\times200}=£\frac{236431\times11\times61}{15\times36500}=$

$£\frac{158\,691\,301}{547\,500}=$ £289 15s. $3\frac{291}{1825}$d.

Grammar.

1 (*a*)

Sentence.	Subject.	Predicate.	Object:	Extension.	Connective.
(1) Let it be remembered (Principal)	(*you*)	let	it (*direct*) (*to*) be remembered (*complement*)		
(2) that to write, however ably, merely to convince those displays but the courage of a boaster [*Subord. noun sent. in apposition with 'it' in (1)*]	to write .. to convince those	displays	the courage of a boaster	but (*deg.*)	that
(3) Who are already convinced. [*Adj. sent. to 'those' in (2)*]	who	are convinced		already (*time*)	

(*b*) *let*—trans. verb, irreg. *let, let, let*, imper. and pers. plur. agreeing with subj. (*you*).

it—pers. pron., 3rd pers. (having a forward reference to the clause '*that to write, etc.....boaster*') neut. sing. obj. by *let*.

be—pres. indef. inf. of *am, was, been*, forming with *remembered*—complete part. of reg. trans. v. *to remember*—the pres. indef. infin. pass. voice. gov. in the infin. without the sign 'to' by *let*.

that—subordinate conj. introducing a noun sentence.
to write—pres. indef. infin. substantive form of the verb *to write*, intrans. irreg. *write, wrote, written*, subj. of *displays*.
however—adv. of degree modifying *ably*.
those—demonstr. pron. 3rd pers. plur. mas. or fem., referring to *(persons)* obj. gov. *to convince*.
convinced—complete part. of reg. verb *to convince*, forming with '*are*' pres. indef. indic. pass. voice.
displays—trans. verb, reg. indic. pres. indef. 3rd pers. sing., agreeing with subj. *to write*.
but—(= only) adv. modifying *displays*.

(c) The *finite* verb is that part of the verb which asserts definitely of its subject or nominative, the three finite moods being the indicative, the subjunctive, and the imperative.

The *infinitive* merely expresses the action or state of the verb without reference to person, number, or time. It cannot be attached to a subject to make an assertion, but it may be joined to a subject in dependent phrases, as '*Let it be remembered.*' It commonly has the force of a substantive, and may be used as the *subject* of a sentence, as, '*to write*, etc., *displays*, etc.'; or the *object* of another verb, as, '*to write to convince.*' As an *object* it is generally governed by certain prepositions (*to* and *but*)—'I cannot but *admire* him.' With 'let' it forms a kind of 1st and 3rd pers. to the imperative, as, 'Let it be remembered.'

(2). The English alphabet is incomplete in the following respects:

(a). It has only twenty-six symbols, four of which are superfluous, to represent more than forty sounds.
(b). Only eight of these symbols are sounded always the same.
(c). The same symbol represents a variety of sounds.
(d). And the same sound is represented in many ways.

Geography.

Notes on 'The lines of Latitude and Longitude, as shown a globe; their meaning and usefulness.'

Meaning—Examine a globe—lines are found drawn from top to bottom, and round it—the important one round the middle, named the *Equator*—8 lines parallel to that above and 8 below—all circles, getting smaller as they near the poles—*Explain why*—called parallels of latitude—show in degrees, minutes, seconds *('division of circles' to be explained)*, the distance of places reckoned in degrees, 1° to 90° from Equator—places above being in north latitude—places below in south latitude; look for these remarkable parallels, tropics of Cancer and Capricorn, Arctic and Antarctic circles *(these terms to be explained)*.—Lines drawn from N. to S., called meridians *(why?)* all same size—all great circles—*(why?)* being all the same, a special one chosen to reckon from, called a '*first meridian*'—places reckoned at so many degrees, etc. E. or W. of first meridian, till they meet at 180°—the British choose for their first meridian, the one passing through Greenwich Observatory; the French, the one through Paris. Other countries, generally the one passing through the capital. (The *Knot*, geographical or nautical mile, to be explained as one minute or 21,600th part of earth's circumference at the equator, which knot diminishes towards either pole till it reaches 0—show why.

Usefulness of these lines.—Show that the position of a place cannot be settled by one line; but by the *crossing* of the lines any place can be fixed with the greatest accuracy. Give exercises at first in finding places whose latitude and longitude present little difficulty. Show the *convenience* of these lines in fixing the place of a shipwreck in mid-ocean, and hence a means of filling charts when latitudes and longitudes have been got—the *service* of these cross-lines to the navigator, who, with proper instruments, can determine at any time his position in degrees, etc., N. or S. of the equator, and how many degrees, etc., E. or W. of Greenwich. Instance the danger of *losing the reckoning*.

(2). *Coral Islands*, with few exceptions, are found only within the tropics, and oftenest in the Pacific Ocean, and appear to be formed on the tops of submarine eminences which are gradually sinking with the bed of the sea. This opinion, expressed by Darwin, is grounded on the fact that the creatures which make the coral can only work between the surface and 90 to 150 feet deep; and as the coral goes down much beyond that depth, it is inferred that the islands have been gradually sinking, which allows the animals to keep adding to the top, as they are still doing. The coral usually forms a ring from one to thirty miles in diameter, and about a quarter of a mile in width. These islands are called 'Atolls.' When coral comes near the surface it is called a reef, the one off Queensland being a natural breakwater 1000 miles long.

History.

	A.D.
1. The death of William I. was the result of an accident received on horseback	1087
William II. is supposed to have been assassinated in the New Forest	1100
Richard I. was killed designedly by a young man at the siege of Chaluz	1199
John is supposed to have been intentionally poisoned.	1216
Edward II. was assassinated in Berkeley Castle ...	1327
Richard II. is supposed to have been murdered in Pomfret Castle	1399
Henry VI. is supposed to have been murdered in the Tower	1471
Edward V. was murdered in the Tower	1483
Richard III. was designedly killed at Bosworth ...	1485
Charles I. was executed	1649
William III. was killed by accidentally falling from his horse at Kensington	1702

2. The conquest of Ireland was begun in the reign of Henry II.

The King of Leinster, Dermot, had been expelled from his territory for carrying off another chief's wife, and he applied to Henry for help. The English king had given permission to his adventurous barons to take up the quarrel, and some Norman knights of Wales had first crossed over to Wexford with a force of Norman horse and Welsh infantry in the summer of 1169.

In 1170 Richard, Earl of Pembroke, surnamed *Strongbow*, followed with a larger force, took Dublin, and by marriage with Dermot's daughter became, on Dermot's death, King of Leinster. In 1171 the king landed with a powerful body of knights, received homage from the Irish chieftains, and was received with due submission by Pembroke. Thus was Ireland nominally subdued.

Latterly the revolt of the American colonies, and the example of the French revolution, led to disturbances in Ireland, which culminated in rebellion, 1798. This showed the pressing need of measures to knit Ireland more closely to the interests of Britain. Pitt, in May, 1799, passed through the English Parliament a bill for the Legislative Union of Great Britain and Ireland. In June, 1800, the Irish Parliament was induced to pass it, and on the first day of the present century, January 1st, 1801, the Union began.

3. The most important events so far in the reign of Queen Victoria are:—

	A.D.
Penny Postage Established...	1840
Abolition of the Corn Laws	1846
Repeal of the Navigation Laws	1849
Great Exhibition of the Industries of all nations, and laying of sub-marine telegraph	1851
Russian War	1854-56
Indian Mutiny	1857
Jews admitted to Parliament	1858
New Reform Act	1867
Abyssinian War	1868
Disestablishment of Irish Church	1869
Irish Land Act	1870
Elementary Education Act	1870
Treaty of Washington (settlement of differences with America by arbitration) ...	1872
Irish Land Bill	1881

Composition.

COLONIZATION.

The formation of colonies is amongst the earliest occurrences recorded in history. Phœnicia, Greece, Rome, Venice, and Genoa were all famous for their colonies. The establishment of colonies in distant parts of the world by European nations during the sixteenth century was one of the most important events in the history of the world. Immediately that interest was excited in Europe by the discoveries of Columbus, the desire to acquire new territories seized on the minds of several European nations, and on the English amongst the rest. It would appear that the English are the only people of modern times who can colonize on a large scale successfully. Of European nations, besides the English, that formerly possessed a large colonial empire, the Dutch have retained more than any other.

Colonization has owed its increase to the difficulty of men to obtain employment, to low wages, and to the scarcity of food. Beyond the sea were lands of greatest richness lying unused by man, and by the bringing of the idle people and the waste lands

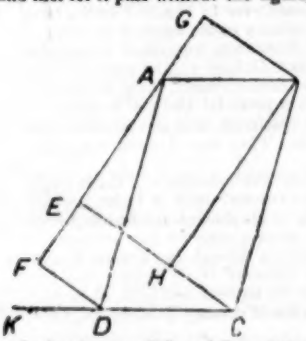
together, the greatest evil of the time was redressed. For a time colonization fell into discredit by the sending of criminals to the newly-acquired possessions, so that honest people refused to take up their abode with men who had committed serious crimes. In course of years the practice of sending convicts was stopped, and thenceforward immigration continued to increase immensely.

Owing to the thinness of population, compared with the size of many of our large colonies, labourers are scarce, and there is a great demand for immigrants. The kinds of people most in demand are farm servants of all kinds, artisans, and domestic servants. To meet the great demand for labour, Government has assisted and even given free passages to properly qualified persons. Free grants of land have been given to those who paid their own passage out.

The advantages conferred by the colonies on the mother country are great, and one of the most valuable is that they furnish a new home for thousands of poor who find it a difficult matter to gain a livelihood in their own country.

Euclid.

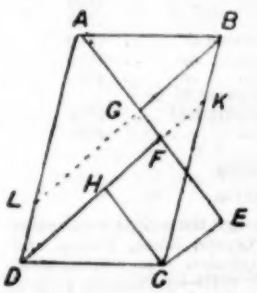
1. Let ABCD be a parallelogram. Through A draw FAG, and first let it pass without the figure, then the perpendiculars on it from B, and D, viz., BG, DF, shall be together equal to the perpendicular on it from C, viz., CE, these perpendiculars being the distances of the respective points from FG.



Through B draw BH parallel to GE; then the figure GBHE is a parallelogram, because BG is parallel to HE, being perpendicular to the same straight line. ∴ BG is = HE.

Again, because BC = AD, and the angle at F = angle at H, each being a right angle, and the angle ADF equal to the angle BCH, which may be shown by producing CD to K, for since the whole ADK = BCD, and the part FDK = to ECD, on account of the respective lines being parallel; then (by I. 26) the triangles AFD, BHC are equal in every respect and ∴ DF = CH. But HE was shown to be equal to BG. ∴ BG, DF are together equal to CE.

Secondly, let the line through A pass within the figure, as AGFE. Then CE shall be equal to the difference between BG and DF. Through C draw CH parallel to EF, then HE is a parallelogram and ∴ HF = CE. Again, because DC = AB, and that the angles at G and H are right angles, and that if BG, DF be produced to L and K, the angles LDK, LBK are equal, being the opposite angles of a parallelogram, ∴ the remainder ABG = remainder CDH, since the whole angle ADC = whole angle ABC. Wherefore (by I. 26) DH = BG, and CE was shown to be equal to HF ∴ CE is equal to the difference between BG and DF.—Q.E.D.



2. Prop. 4, Bk. II.
3. Prop. 14, Bk. II.

Algebra.

1. (a) $(x-2y)^4 = (x^2-4xy+4y^2)^2 = x^4-8x^3y+24x^2y^2-32xy^3+16y^4$

(b) $-(2x-y)^4 = (4x^2-4xy+y^2)^2 = \underline{16x^4-32x^3y+24x^2y^2}$
$\quad -8xy^3+y^4$

Subtracting, there remains $-15x^4+24x^3y \quad -24xy^3+15y^4$

Reversing the terms $15y^4-24xy^3-15x^4+24x^3y =$

$3(5y^4-8xy^3-5x^4+8x^3y =$

Adding and subtracting $5x^2y^2$

$3(5y^4-8xy^3+5x^2y^2-5x^2y^2+8x^3y-5x^4 =$

$3(y^2(5y^2-8xy+5x^2)-x^2(5y^2-8xy+5x^2)$

$3(y^2-x^2)(5y^2-8xy+5x^2) =$

$\underline{3(y-x)(y+x)(5y^2-8xy+5x^2)}$ Q.E.D. Ans.

2. Let $6x$ = the No.

Then by the terms of the problem,

$3x \times 3x = 2x \times 2x \times 2x$

$9x^2 = 8x^3$

$9 = 8x$

$\frac{9}{8} = x$

∴ the No. $= \frac{9}{8} \times 6 = \underline{6\frac{3}{4}}$ or $\underline{\frac{27}{4}}$ Ans.

3. (1) $10x-11y = -12$ or $130x-143y = -156$

$13x-14y = -11{\cdot}7$ or $\underline{130x-140y = -117}$

$3y = 39$

$y = \underline{13}$

By substitution, $10x - 143 = -12$

$10x = 143 - 12$

$10x = 131$

$\underline{x = 13{\cdot}1}$ Ans.

(2) $\frac{7x}{3} + \frac{3-x}{2x} = 20\frac{1}{2}$

Clearing of fractions, $14x^2 + 9 - 3x = 124x$

Transposing, $14x^2 - 127x = -9$

Dividing by 14, $x^2 - \frac{127x}{14} = -\frac{9}{14}$

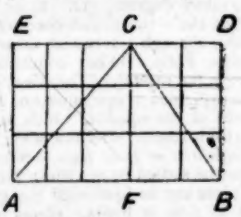
Completing square, $x^2 - \frac{127}{14}x + \left(\frac{127}{28}\right)^2 = \frac{16129-504}{784} = \frac{15625}{784}$

Taking root, $x - \frac{127}{28} = \frac{+125}{-28}$

$x = \frac{127}{28} \pm \frac{125}{28} = 9$ or $\frac{1}{14}$

Mensuration.

1. The altitude of a triangle is the perpendicular let fall from the vertex upon the base or the base produced. Let ABC be a triangle, and ABDE a rectangle on the same base AB, and having the same altitude: the triangle is equal to half the rectangle.



Let CF be the perpendicular from C on AB. Then the triangle ACB is half of the rectangular parallelogram AEDB.

Now it may be easily shown (by dividing the sides and drawing parallel lines) that the product of the linear units in AE or FC, and similar linear units in ED, is equal to the number of square units in the whole rectangle, and since the area of the triangle is equal to half the area of the rectangle, then the rule may be written thus:—*The area of a tridngle is half the product of the base and the altitude*, which is the same result as if the area of the rectangle was found and then halved.

2. (a) 120ft. × 60ft. = 7,200 sq. ft. = 800 square yards.

A square chain = 22 yards × 22 yards = 484 square yards.

484 square yards cost 121s.

1 „ „ $\frac{121s.}{484}$

800 „ „ $\frac{121s. \times 800}{484}$

i.e., $\underline{\pounds 10}$

(b) 78ft. × 36ft $= \frac{78 \times 36}{9}$ square yards $= 312$ sq. yds.

4d. × 312 = 104s. = £5 4s.

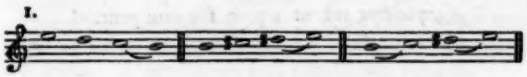
Cost of levelling = £10

„ tennis court = 5 4s.

∴ total cost = £15 4s.

Music.

1.



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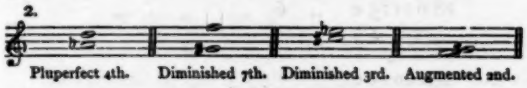
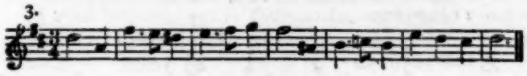


Pluperfect 4th. Diminished 7th. Diminished 3rd. Augmented 2nd.

3.



—o—

Engagements for January.

January 4.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
,, 6.	Finance of Orphanage, N.U.E.T.	7.30 p.m.
,, 7.	Meeting of Executive, N.U.E.T.	11 a.m.
,, 9.	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
,, 11.	Geological Society	8 p.m.
	Anthropological Society	8 p.m.
,, 12.	Royal Society	4.30 p.m.
,, 13.	Finance Committee of Benev. Fund, N.U.E.T.	7 p.m.
	New Shakspere Society	8 p.m.
,, 16.	Central Committee of Benev. Fund, N.U.E.T.	7.15 p.m.
,, 18.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
,, 19.	Royal Society	4.30 p.m.
	Linnean Society	8 p.m.
,, 20.	Meeting of Executive, N.U.E.T.	7 p.m.
,, 21.	Organisation Committee, N.U.E.T.	10 a.m.
	General Board, N.U.E.T.	11 a.m.
,, 23.	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
,, 25.	Geological Society	8 p.m.
	Anthropological Society Anniversary	8 p.m.
,, 26.	Royal Society	4.30 p.m.
,, 27.	Browning Society. James Thomson on 'Browning's Genius.'	8 p.m.

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'How I Teach Arithmetic.'

(*Continued from page* 432.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

We shall next, in somewhat natural sequence, as we have step by step been working up to it, consider the teaching of that important branch of Arithmetic comprehended under the generic term *Percentages*—the commercial or higher-business man's practical Arithmetic. The word has, in the singular number, for some years obtained such a terrible ascendancy in the scholastic vocabulary that it has almost come to have the same effect on the profession that a red flag has on the lord of the bovine creation. Here, however, we trust it will be found perfectly innocuous.

In commencing the teaching of Percentages, I first try to instil into the minds of the scholars a clear idea of the meaning of the term *per cent.*—so much or so many per 100. When money is referred to, it means on each 100 *pounds*, and when any other concrete number is considered, it means so many out of each 100 of that number. For instance, when we speak of money making 5 per cent. interest, or of goods being sold at a profit of 15 per cent., we simply mean in the former case that £100 makes £5 interest, or that some principal greater or less than £100 makes at the *rate* or proportion of £5 for £100; and in the latter case that goods bought for £100 were sold at a profit of £15, thus selling for £115; or at the *rate* of £15 profit on £100, whatever the money originally spent on the goods might be. When concrete numbers other than money are referred to, as 20 per cent. of a number of boys, it denotes 20 boys out of 100 boys, or that proportion of the boys, whatever the number on which the percentage to be taken might be.

I now give a number of easy examples to be worked mentally:—Find the interest of £200 at 5 per cent.; £250 at 4 per cent.; £650 at 3 per cent.; £825 at 6 per cent. In the last example explain—each of the others being, however, explained if required—that £825 = 8¼ hundreds, consequently the interest will be 8¼ times £6 = £49 10s. Give a score or two of such questions till even the slower ones are able to answer, having heard question after question worked out.

Now work out mentally some other concrete exercises—not money. In a school of 200 children, 5 per cent.—that is, per 100—are late; how many are late? Out of 300 four per cent. were late? Out of 250 two per cent. were late? Here, as 250 = 2½ hundreds, there must have been 2½ times 2 = 5 scholars late. I now present a different phase of these exercises:—If 10 boys are late out of 200, what is the rate per cent.? If 12 are late out of 300? If 15 are late out of 250? Here 250 = 2½ hundreds, and as we want to know how many were late out of every 100, then 15 ÷ 2½, or 30 ÷ 5 = 6 per cent. Ans.

Having given some general notion of the application of the term *per cent.*, we will now consider *seriatim* and in detail the various specific operations included in the general term Percentages.

(*a*) The sub-division generally taken first is *Simple Interest*, with which we at once proceed. I first define interest—money paid for the loan of a sum of money, called the principal; and rate per cent. as previously defined, remarking that this rate is so much for *one* year, unless otherwise specially mentioned. We now at once commence working exercises freely on the board, the first being in finding (*a*1) the *simple interest of a sum of money for a given time*, and first for a year. Find the interest of £420 at 5 per cent. We will work this exercise by different methods, in order that the *rationale* may be thoroughly understood, so that in the future working of such questions the method that commends itself as the easiest in any particular case can be easily resorted to. (1) I explain that 5 per cent. = $\frac{5}{100} = \frac{1}{20}$, hence that the interest is $\frac{1}{20}$ of the principal, so that £420 ÷ 20 = £21. Ans. In practice I adopt this plan more frequently than any other. (2) As £420 = 4⅕ hundreds, £5 × 4⅕ = £21. Ans. This method is convenient when the principal can be easily expressed in hundreds and the decimal or fraction of a hundred. (3) As 5 per cent. is $\frac{1}{20}$, the interest is just a shilling for every £ in the principal, hence the interest must be 420 shillings = £21. Ans. This method is handy when the rate is also 2½ per cent., that is, sixpence in the £, or $\frac{1}{40}$; also when it is 3¾ per cent., that is, ninepence in the £. The application of this method is limited, being only available when the rate is a multiple or sub-multiple of those just given—thus 7½ per cent. = 1s. 6d. in the £, 1¼ per cent. = 3d. in the £, or $\frac{1}{80}$, etc. (4) *One* per cent. of £420 = £4·2, hence £4·2 × 5 = £21. Ans. This method is useful when there are £'s only—no shillings and pence—or when these will easily come out in the terminate decimal of a £. (5) Multiply by the rate per cent. and divide by 100, then (£420 × 5)

$\div 100 = £21$. Ans. This is the most common, but the least rational, method adopted, being in principle the same as method 4, the multiplying being done before the dividing; but the 'rule' is too generally resorted to without an intelligent appreciation of its reason.

We will now work out a few examples, and make them the basis of any remarks that may be required. Find the interest of £625 12s. 6d. at 4½ per cent.

(1)

	£	s.	d.
4 p. c. is $\frac{1}{25}$	625	12	6
½ „ „ $\frac{1}{8}$	25	0	6
	3	2	$6\frac{3}{4}$
Ans.	£28	3	$0\frac{3}{4}$

(2)

	£
4 p. c. is $\frac{1}{25}$	625·625
½ „ „ $\frac{1}{8}$	25·025
	3·128125
	£28·153125
	20
	s. 3·0625[00]
	12
	d. 0·75[00]

(3)

£	s.	d.
625	12	6
		4½
2502	10	0
312	16	3
£28·15	6	3
	20	
s. 3·06		
	12	
d. 0·75		

(4)

6·25625
4·5
3128125
2502500
£28·153125. Ans.

The scholars who work percentages being fairly up in fractions and decimals, each of the above methods is easily intelligible to them. In No. 1 we have taken 4 per cent., which is $\frac{1}{25}$ of 100, and then ½, which is $\frac{1}{8}$ of the 4. A boy at this stage ought to be so well up in mechanical working that he can easily divide by 25 by short division. In No. 2 we have brought the 12s. 6d. to the decimal of a £, which most boys can easily do mentally,—being $\frac{6}{8} = .625$. We then proceed as in No. 1. In No. 4 we have mentally divided the £625·625 by 100 = £6·25625, which is the interest at *one* per cent., and then multiplied by the rate required—4½. In No. 3 we have adopted method 5 as referred to above. In giving a class an early lesson, I exhibit all these methods simultaneously on the board, and remark well on each of them, leaving the scholars to adopt which measure they prefer in their own working.

Another example,—What is the simple interest of £476 13s. 9d. for 4½ years at 6 per cent. per annum?

(1)

	£	s.	d.
5 p. c. is $\frac{1}{20}$	476	13	9
1 „ „ $\frac{1}{5}$	23	16	$8\frac{1}{4}$
	4	15	$4\frac{1}{20}$
int. for 1 yr.	£28	12	$0\frac{3}{10}$
			4½
	114	8	$1\frac{1}{5}$
	14	6	$0\frac{3}{20}$
Ans.	£128	14	$1\frac{1}{20}$

(2)

£4·766875 int. at 1 p. c. for one year.
6
28·60125 0 „ 6 „ „ „
4·5
14300625 0
114405000
£128·7056250 „ „ „ 4½ years
20
s. 14·11250[00]
12
d. 1·350[00]

(3) £476 13s. 9d. × 6 × 4½ = £12870 11s. 3d., which divided by 100 = £128 14s. $1\frac{1}{20}$d. Ans.

Method 1 above is self-evident. In method 2 we have £476 13s. 9d. = £476·6875 = £4·766875 *hundreds* of £'s, the remainder being easy to follow. In this case method 3 is the shortest, though the least rational. I here explain that instead of dividing the principal by 100 at first, and then multiplying by 6 and 4½, we simply multiply first, and then divide afterwards.

I should now explain the term *amount*—the sum obtained when the interest has been added to the principal—and work a question requiring it. What is the amount of £756 15s. for 3 years 10 months at $3\frac{1}{3}$ per cent. per annum? Here, first elicit that $3\frac{1}{3}$ is $\frac{1}{30}$ of 100, hence that a year's interest is $\frac{1}{30}$ of the principal—£756 15s. ÷ 30 = £25 4s. 6d., a year's interest. Then, 3 years 10 months = $3\frac{5}{6}$ years, hence £25 4s. 6d. × $3\frac{5}{6}$ = £96 13s. 11d. the total interest, which added to the principal £756 15s. = £853 8s. 11d., the amount. Ans.

(*a2*) We will now *find the rate per cent.* when the interest of some specified principal for a given time is known.

Example:—At what rate per cent. will £450 amount to £508 10s. in $3\frac{1}{4}$ years? Here reiterate what rate per cent. really means—the interest of *one* hundred £ for *one* year; and we have in the question the interest of a *number* of hundred £'s (4½) for a *number* of years ($3\frac{1}{4}$).

£508 10s. − £450 = £58 10s., int. of £450 for $3\frac{1}{4}$ yrs.

£58 10s. ÷ 4½ (hundreds) = £13, int. of £100 for $3\frac{1}{4}$ yrs.

£13 ÷ $3\frac{1}{4}$ (years) = £4, int. of £100 for 1 yr. Ans.

Another example:—At what rate would £162 10s. amount to £184 8s. 9d. in 4½ years, simple interest? We will work this question decimally. £162 10s. = £162·5 = 1·625 hundreds, and £184 8s. 9d. = £184·4375, then

£184·4375 − £162·5 = £21·9375, int. of 1·625 hrds. for 4½ yrs.

£21·9375 ÷ 1·625 = £13·5, int. of 1 hrd. for 4½ yrs.

(£13·5 ÷ 4½) = (£27 ÷ 9) = £3. Ans. Int. of 1 hrd. for 1 year

We will also work this question by compound proportion—

£184 8s. 9d. − £162 10s. = £21 18s. 9d. = £21$\frac{15}{16}$ = £$\frac{351}{16}$, the interest on £162 10s. for 4½ years. £162 10s. = 1$\frac{5}{8}$ hundreds = $\frac{13}{8}$ hundreds. 4½ years = $\frac{9}{2}$ years. Then stating and cancelling, we have—

$$27\ \frac{\cancel{351} \times \cancel{8} \times \cancel{2}}{\cancel{16} \times \cancel{13} \times \cancel{9}} = \frac{27}{9} = £3. \text{ Ans.}$$

In cancelling, the 8 × 2 eliminates the 16, and the 13 goes into the 351. Proportion is often the shortest method of doing this kind of question, as it is in this case.

(*a*3) We will next *find the time* in which a sum of money will make a given amount of interest in a specified time. Example:—In what time would £1,625 amount to £1,824 6s. 8d. at 3$\frac{1}{3}$ per cent. per annum? Here we simply work on first principles, finding the interest produced in *one* year, and then seeing how often this one year's interest is contained in the given interest. £1,824 6s. 8d. − £1,625 = £199 6s. 8d. the given interest. £1,625 = 16$\frac{1}{4}$ hundreds, and (£3$\frac{1}{3}$ × 16$\frac{1}{4}$) = ($\frac{10}{3}$ × $\frac{65}{4}$) = £52, the interest for *one* year; then £199 6s. 8d. ÷ £52 = 3$\frac{5}{8}$, the number of years = 3 years 10 months. Ans. In dividing, the £199 6s. 8d. = £199$\frac{1}{3}$ by £52, bring both to thirds of £'s = 598 ÷ 156 = 3$\frac{30}{156}$ = 3$\frac{5}{26}$ years. Ans. In teaching a class I should here remark that although one sum of money cannot be *multiplied* by another, both being concrete numbers, we may by dividing see how often one sum of money is contained in another, just on the same principle as we find (say) how many times 9 apples is contained in 72 apples. A caution here is needed that the quotient obtained is not money (£ s. d.), but an abstract number, representing, however, it may be, something concrete, as 3$\frac{5}{8}$ *years* above.

Before commencing to divide, the two amounts should be brought to the same denomination.

Another example:—In how many years would £600 amount to £750 at 3$\frac{3}{4}$ per cent. per annum? We will work this question by compound proportion, first reading it in a more explicit form, thus:—If £100 makes £3$\frac{3}{4}$ (= £$\frac{15}{4}$) interest in one year, in how many years will £600 make (£750 − £600 =) £150 interest at the same rate? First bringing the two amounts of interest, £3$\frac{3}{4}$ and £150, to *fourths* of £'s, to get rid of the fraction ($\frac{3}{4}$), we have 15 and 600; then stating, we have:—

year. pr. interest.

$$\frac{1 \times 1 \times 4\cancel{0}\cancel{0}\cancel{0}}{6 \times \cancel{15}} = \frac{40}{6} = 6\tfrac{2}{3} \text{ years. Ans.}$$

In the above statement we have represented the two principals in *hundreds* of £'s, their simplest ratio, instead of £$\frac{100}{600}$.

(*a*4) We now proceed to *find the principal* which will amount to a certain sum, or, in other words, produce a specified interest in a given time at a given rate per cent. Example:—What principal at simple interest would amount to £487 18s. at 4 per cent. for 4$\frac{3}{4}$ years? Here we might find what *any* principal would amount to at 4 per cent. for 4$\frac{3}{4}$ years, and then whatever fraction or proportion this supposed principal is of its amount, so the principal required will be of the given amount—£487 18s. The most convenient supposed principal is £100, then £4 × 4$\frac{3}{4}$ = £19, interest of £100 for the given time; hence £100 would *amount* to £119, consequently the principal is $\frac{100}{119}$ of the amount, and $\frac{100}{119}$ of £487 18s. = £410. Ans. The simplest method of obtaining $\frac{100}{119}$ of £487 18s. is by representing it as £487·9, then mentally multiplying it by 100 = £48,790, which divided by 119 = £410.

Another example:—What principal will amount to £369 0s. 2½d. in 4$\frac{1}{6}$ years at 3$\frac{1}{4}$ per cent. per annum? Here £3$\frac{1}{4}$ × 4$\frac{1}{6}$ = $\frac{13}{4}$ × $\frac{25}{6}$ = $\frac{325}{24}$ = £13$\frac{13}{24}$, interest of £100 for the 4$\frac{1}{6}$ years, hence £100 would amount to £113$\frac{13}{24}$ in the given time; the principal is therefore $\frac{100}{113\frac{13}{24}} = \frac{2400}{2725} = \frac{480}{545} = \frac{96}{109}$ of the amount, then (£369 0s. 2½d. × 96) ÷ 109 = £325. Ans.

As every question in simple interest must come under one or other of the above four headings, before proceeding further I devote a week or two to working out a number of dissimilar questions, so as to bring into requisition the knowledge acquired. Here the first 80 questions from 'Percentages' in my own series come in opportunely, and are supplemented by a number of questions from Colenso's, Mansford's, or any other manual of arithmetic, and by setting *ad libitum* original questions on the board. In working original questions I very rarely have any difficulty in ascertaining the true answer, as when three or four of the best workers have honestly the same answer, they are nearly certain to be right. Should there be the least doubt, I work out the question on the board in presence of the whole class. I would here remark that in finding the interest of a sum of money from one date to another, the worker is often in doubt whether he should reckon *both* the given days, or only *one* of them, or *neither* of them. Of course the true interest, as a banker would reckon it, and as common sense would suggest, would be obtained by reckoning one of the days only, if no directions were given; as a sum of money invested one day and taken out the next would only be one day at interest, or if invested one (say) Monday and taken out the next Monday would only bear 7 days' interest, not 8 days. For instance, from April 14th to July 26th, I should reckon 16 days for April, omitting the 14th, but reckoning July 26th, making in all 103 days; hence the interest for these days would be $\frac{103}{365}$ of a year's interest. In every question in arithmetic, the data should be explicit, nothing doubtful or ambiguous about them; yet nearly in every batch of questions issued by the Education Department, whether to pupil teachers, Queen's scholars, or students, I can find one or more questions puzzlingly lacking in definiteness. If the full working of a question is carefully looked over by the examiner, which takes considerable time, so that the view the worker had of what was required is appreciated, and the work be valued accordingly, not much harm will be done; but if only a specific result (answer) must be obtained, then the worker may be seriously wronged. I remember many years ago a pupil teacher being shown his worked paper by an Inspector, who told him gravely that one of the questions was seriously wrong—and seriously wrong it certainly was in the answer—and casting my eye cursorily over his paper I saw and pointed out that this 'serious wrong' was, that in a question in interest, in which the answer was to be the *amount*, he had only given the *interest*—his omission to add the interest to the principal.

(To be continued.)

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add together,—three hundred and eighty-nine, fifty-seven, eight hundred and sixty, seven hundred and twenty-six, and five hundred and sixty-four. Ans. 2596.

(2) From six hundred and forty-three, take four hundred and seventy-nine. Ans. 164.

(3) Find the difference between seven hundred and five, and two hundred and sixty-nine. Ans. 436.

STANDARD II.

(1) Multiply sixty-eight thousand four hundred and seventy-five, by seventy-eight. Ans. 5,341,050.

(2) Divide sixty-nine thousand nine hundred and thirty-one, by nine. Ans. 7770,—1.

(3) From sixty-four thousand two hundred and fifty, take thirty-nine thousand eight hundred and twelve. Ans. 24,438.

STANDARD III.

(1) Divide four millions and seventy-six thousand three hundred and sixty-one, by six hundred and seventy-three. Ans. 6057.

(2) Add together,—eight hundred and forty three pounds thirteen shillings and eightpence three farthings, one hundred and sixteen pounds six shillings and elevenpence, eight thousand and ninety-four pounds eight shillings and fourpence halfpenny, three hundred and nineteen pounds three shillings and threepence three farthings, and six thousand and twenty-eight pounds eighteen shillings and sixpence halfpenny. Ans. £15,402 10s. 10½d.

(3) Find the difference between twenty-three thousand eight hundred and forty-three pounds thirteen shillings and sixpence halfpenny, and nine thousand nine hundred and eighty-nine pounds seventeen shillings and sixpence three farthings.

Ans. £13,853 15s. 11¾d.

(4) I pay £13 17s. 11½d. to one person, and £29 2s. 6d. to another. I then receive £8, and find £9 5s. 0d. in my purse when I get home. How much had I at first? Ans. £44 5s. 5½d.

STANDARD IV.

(1) Multiply seven hundred and fifty-five pounds twelve shillings and ninepence farthing, by ninety-two. Ans. £69,518 14s. 11d.

(2) Divide five hundred and twenty-eight thousand and seventy-six pounds ten shillings and a penny three farthings, by five hundred and twenty-seven. Ans. £1002 0s. 10¼d.

(3) Bring eleven million and twenty-two ounces to tons. Prove the answer. Ans. 306 tons 18 cwt. 1 qr. 17 lbs. 6 oz.

(4) How many persons can receive 15s. 1d. each out of £40 14s. 6d? Ans. 54 persons.

STANDARD V.

(1) 3191 @ £1 9s. 5¾d. Ans. £4703 8s. 0¼d.

(2) 79 cwts. 3 qrs. 16 lbs. @ £2 12s. 6d. a cwt. Ans. £209 14s. 4½d.

(3) 23 yards @ 5s. 6d. per yard.
33 " 0s. 11⅜d. "
2 dozen gloves @ 1s. 10d. per pair.
10 yards @ 1s. 10d. per yard.
Ans. £9 19s. 1¾d.

(4) If 98 sheep cost £352, what would 2 cost? Ans. £7 3s. 8$\frac{4}{49}$d.

STANDARD VI.

(1) Divide the sum of $\frac{1}{12}$ and $(\frac{1}{4} - \frac{1}{8})$ by the sum of $\frac{1}{3}$, $\frac{1}{6}$, $\frac{1}{8}$; and find the value of $(3\frac{1}{2} \times 2\frac{1}{3}) \div (\frac{4}{15} \times \frac{8}{9})$ of £3. Ans. $\frac{15}{44}$; £81 13s. 4d.

(2) If 20 men do a piece of work in 12 days, working 9 hours a day, how many men will do twice as much work in 8 days, working 6 hours a day? Ans. 90 men.

(3) A man owns ·375 of a ship. He sells $\frac{2}{3}$ of his share for £1260. What will be the value of the whole ship? Ans. £5040.

(4) 37·004 × ·00473. Divide the product by ·1892. Ans. ·9251.

Dictation.

STANDARD I.

The wool of the sheep is white.

STANDARD II.

There he is safe from the dogs but not from the guns of the hunters. But they dare not go too near, lest he should spring upon them. They keep at some distance and try to shoot him.

STANDARD III.

If another soldier comes up he will seize his comrade, and so help him to pull away the others. They are so bitter against their enemies, that they will sooner suffer themselves to be torn in pieces than let go their hold. Some kinds will attack others that are twice as big as themselves, trusting to their superior numbers and going two against one.

STANDARDS IV., V., and VI.

The forest is now almost dark, the foliage overhead having become so dense that the moon penetrates through it only in a few places, rendering the surrounding mosses darker by contrast. The outline of an old shoe-track, at first faintly seen, is soon no longer visible; but still the Indian moves forward with rapid, noiseless steps, as sure of his way as if a broad beaten track lay before him.

Grammar.

STANDARD IV.

Parse these sentences:—

1. What shall I say?
2. Whose flowers will he bring?
3. Whom will they seek next?

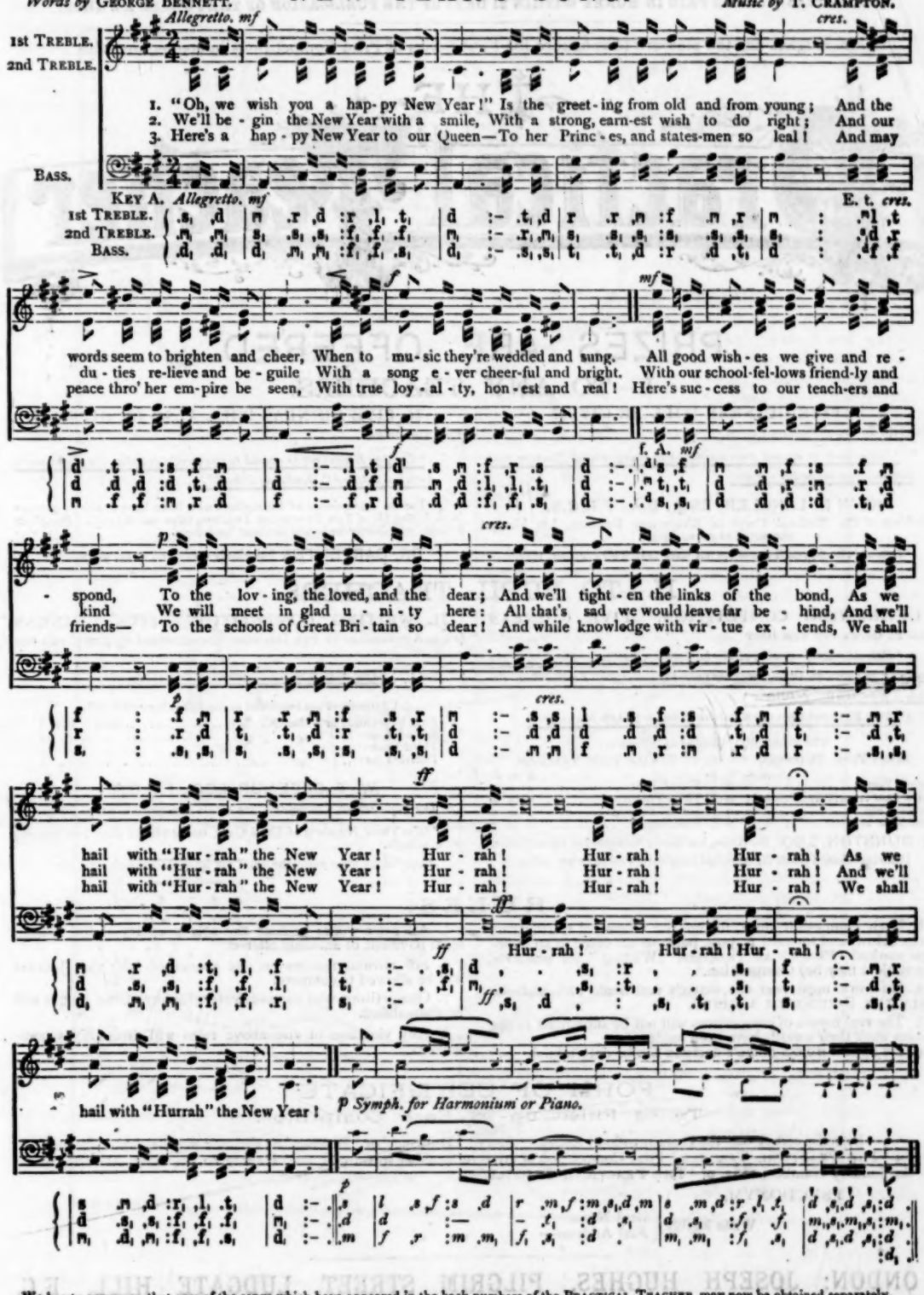
STANDARD V.

1. Parse:—
   (*a*) The women had just left their room.
   (*b*) I have been there.
   (*c*) Jane will be lost.
2. Analyse:—
   There is no doubt at all about the truth of George's sayings.

STANDARD VI.

1. Parse:—
   (*a*) All is not gold that glitters.
   (*b*) Playing with edged tools is dangerous.
   (*c*) Let all remain but you.
2. Analyse:—
   If you tell me that it is wrong to do so, I will of course attend to you.

NEW YEAR'S SONG.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

Allegretto. mf
cres.
1st TREBLE.
2nd TREBLE.
BASS.
1. "Oh, we wish you a hap-py New Year!" Is the greet-ing from old and from young; And the
2. We'll be-gin the New Year with a smile, With a strong, earn-est wish to do right; And our
3. Here's a hap-py New Year to our Queen—To her Princ-es, and states-men so leal! And may
KEY A. Allegretto. mf
E. t. cres.
words seem to brighten and cheer, When to mu-sic they're wedded and sung. All good wish-es we give and re-
du-ties re-lieve and be-guile With a song e-ver cheer-ful and bright. With our school-fel-lows friend-ly and
peace thro' her em-pire be seen, With true loy-al-ty, hon-est and real! Here's suc-cess to our teach-ers and
f. A. mf
cres.
-spond, To the lov-ing, the loved, and the dear; And we'll tight-en the links of the bond, As we
kind We will meet in glad u-ni-ty here: All that's sad we would leave far be-hind, And we'll
friends— To the schools of Great Bri-tain so dear! And while knowledge with vir-tue ex-tends, We shall
cres.
hail with "Hur-rah" the New Year! Hur-rah! Hur-rah! Hur-rah! As we
hail with "Hur-rah" the New Year! Hur-rah! Hur-rah! Hur-rah! And we'll
hail with "Hur-rah" the New Year! Hur-rah! Hur-rah! Hur-rah! We shall
Hur-rah! Hur-rah! Hur-rah!
hail with "Hurrah" the New Year!
p Symph. for Harmonium or Piano.

We beg to announce that any of the songs which have appeared in the back numbers of the PRACTICAL TEACHER may now be obtained separately, price 6d. per dozen, post free.

TWENTY-GUINEA PRIZE COMPETITION.

THE PRIZES WILL BE PAID IN MONEY WITHIN 21 DAYS OF THE PUBLICATION OF THE JUDGES' AWARDS.

Mr. Hughes has the pleasure to announce his First Series of Prize Competitions in connection with

PRIZES ARE OFFERED

I.—TO ANY TEACHERS.

I. FIVE GUINEAS WILL BE GIVEN

FOR THE BEST

'Letter (not to exceed 5000 words) to a young Pupil Teacher just commencing his or her career.'

JOHN R. LANGLER, ESQ., B.A., F.R.G.S.,

President of the National Union of Elementary Teachers, has kindly consented to act as Judge.

'Letters' should reach the office not later than February 1st, 1882.

II. FIVE GUINEAS WILL ALSO BE GIVEN

FOR THE BEST

'Story or Essay (not to exceed 10,000 words) based on Dr. Carpenter's Articles, entitled "Health at School."'

*** For the convenience of Subscribers who have been unable to procure Nos. I. and II. of THE PRACTICAL TEACHER (now out of print), 'Health at School' will shortly be issued in cheap book form.

DR. CARPENTER has kindly consented to act as Judge.

II.—TO PUPIL TEACHERS.

I. DRAWING COMPETITION. FIVE GUINEAS WILL BE GIVEN FOR THE BEST

'Reproduction, any size, either in Crayons, outline or Colours, of the Drawing by Gunston, in the January (1882) Number of "THE PRACTICAL TEACHER," entitled

"THE ENGLISH CHILDREN IN THE ROMAN SLAVE MARKET."

The Prize will be divided as follows:—

MALE PUPIL TEACHERS.	£ s. d.	FEMALE PUPIL TEACHERS.	£ s. d.
Fourth Year	1 0 0	Fourth Year	1 0 0
Third Year	0 15 0	Third Year	0 15 0
Second Year	0 10 0	Second Year	0 10 0
First Year	0 7 6	First Year	0 7 6

W. GUNSTON, ESQ., the Artist, has kindly consented to act as Judge.

Drawings should reach the office not later than February 1st, 1882.

II. WRITING COMPETITION — FIVE GUINEAS (TO BE AWARDED AS IN THE DRAWING COMPETITION) WILL BE GIVEN FOR THE

'Three Best-Written Numbers of Cox's Copy Books.'

Competitors are restricted to the following numbers:—

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Second Year " "	"	9, 10, 11
Third Year " "	"	5, 12, 13
Fourth Year " "	"	3, 14, 15

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The Leys School, Cambridge, has kindly consented to act as Judge.

*** The Three Numbers of Cox's Copy Books will be sent, post free, for 6d. in stamps.

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RULES.

1. Each competitor must fill up the 'Form of Certificate' given below, and forward it, post paid, to our office in an envelope marked 'PRACTICAL TEACHER "Writing" (or whatever the subject may be) Competition.'
2. No work must bear the writer's real name and address, ONLY THE PSEUDONYM ADOPTED.
3. The real names of competitors will not be submitted to the judges until their awards have been made.
4. No appeal from a judge's decision can be entertained.
5. All prize-works become the sole property of the Editor upon payment of amounts offered.
6. For obvious reasons no one connected with this Journal will be allowed to compete.
7. Competitors who communicate with any of the judges will be disqualified.
8. Any violation of the above rules will disqualify a competitor.

FORM OF CERTIFICATE

To be Filled up by Each Competitor.

I hereby certify that the (here mention 'Letter,' 'Story,' 'Drawing,' or 'Writing,' as the case may be) I now forward for 'THE PRACTICAL TEACHER' Prize Competition is my own unaided work, and that I agree to the rules set forth in the January Number, 1882, of 'THE PRACTICAL TEACHER.'

PSEUDONYM,

Write legibly { Real Name—
Full Address—

LONDON: JOSEPH HUGHES, PILGRIM STREET, LUDGATE HILL, E.C.

THE ENGLISH CHILDREN IN THE ROMAN SLAVE MARKET.

The Practical Teacher.

A MONTHLY EDUCATIONAL JOURNAL.

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P. O. Orders should be made payable at Chief Office.

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It would save time and expense if subscribers when remitting would state exactly what numbers they wish to be sent.

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Accepted contributions are paid for within twenty-one days of publication.

The Editor cannot return rejected MSS.; authors should therefore retain copies.

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Approved, *prepaid*, advertisements will be inserted in the *Practical Teacher* at the following rates:—

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☞ **Portfolios, fitted with elastic bands, for preserving twelve numbers of 'The Practical Teacher,' may now be had. Price 2s. 6d., post free.**

Nos. I. and II. of The *Practical Teacher* are now out of print.

**** *We regret that, owing to the great pressure upon our space, the 'Monthly Notes' and 'Gossip' are again crowded out.*

The Hon. Lyulph Stanley, M.P., and the Westminster Training College.

BY THE EDITOR.

ALL well-informed friends of denominational education who peruse the proceedings of the London School Board must have been more annoyed than alarmed at some remarks made by a prominent member on the 10th ult. The business which occupied the Board's attention was a 'Memorial to the Lords of the Committee of Council on Education' on what the now defunct 'Teacher' was pleased to style 'The Training College shibboleth.' In the course of the debate, which was opened by the Rev. Thomas Morse, the Hon Lyulph Stanley, M.P., is reported by one of our contemporaries to have said:—

'He must say, from what he had heard from teachers who had gone through colleges, of the discipline, the treatment, and the attitude of the principals towards the young people, that the relation in which they seemed to stand to the principals was that of third or fourth standard children in elementary schools. He knew of one college in which there was a want of generosity and a want of trust in the honour of the students, which he thought would be discreditable to any school, even one in the poorest part of the metropolis.'

At this point, a Churchman—jealous, we presume, of the honour of the institutions whose interests he represented—promptly pulled him up by demanding the name of the College.

'The Hon. Lyulph Stanley said it was not a Church college. It was the Westminster Training College, and he had the information before him.'

As an old student of this College, we cannot let these scurrilous remarks pass unchallenged. After making allegations so grave as these, in common justice to his informer, himself, and, above all, to Westminster, 'the information before him' should no have been withheld. It seems to us a pity this bald statement, unsupported by one tittle of evidence, should have gained currency.

We highly respect Mr. Stanley for his past services to the profession; the manful way in which he stood by Mr. Goffin should win for him the abiding gratitude and esteem of every teacher in the country. The part he played in that unpleasant business was a noble one; it is not lightly valued, nor will it soon be forgotten.

But in this case we cannot but think he has been duped by some chagrined individual seeking to do harm to a most worthy institution. The charges which he prefers against Westminster are as groundless as they are serious. We ought to know something of the 'want of generosity' and 'want of trust in the honour of the students,' if these things exist, considering that our acquaintance with the Westminster College now extends over a period of fourteen years. Two of these years were passed within its walls as a student, and we deem it a privilege, as it is a pleasure, to emphatically deny that there exist the slightest

grounds for the complaints made by Mr. Stanley. And we feel sure, that in so speaking, we answer (almost to a man) for the hundreds of our personal friends who were trained at Westminster. It is not saying too much when we affirm that there is no set of men who entertain a sincerer regard for their *Alma Mater*, and who are more loyal to the permanent staff, than old Westminsters.

That occasionally a black sheep has disgraced himself, and has had dealt out to him a well-merited chastisement, we do not deny, but in what college or profession has this not been the case?

We believe that even the profession which the Hon. Member for Oldham adorns is not exempt from these black sheep.

Mr. Stanley has evidently taken for granted the truth of his information without making due enquiry. He surely is ignorant, and grossly so, of the character of the men at whose door these charges are practically laid. Had he had even a passing acquaintance with the Vice-Principal—not to speak of Dr. Rigg, his respected and vigorous chief—he would have known how impossible it was for the state of things which he describes to exist. Whatever other colleges may be—and we have not a single word to set down against any of them—Westminster yields to none in her honourable, generous, kindly—nay, affectionate treatment of her students; and all who are able to speak with the authority of knowledge will bear us out when we say that this truly honourable dealing is heartily reciprocated by the students, both present and past.

But supposing, for the sake of argument, that we allow that the lamentable picture with which Mr. Stanley presents us is, and has been for years, a true one, how comes it that Westminster men have the very best schools in the country—schools in which it is the practice to spend at least one hour a day in religious teaching? We make this statement not on our own authority, but on that of Mr. Mundella himself. The Vice-President, in replying to the Wesleyan deputation which waited upon him on November 23rd, said, 'Yours are the best schools of the country, and take the largest grant.'

This result seems strangely at variance with the discipline of the College where the masters of these schools were trained—a discipline that 'would be discreditable to any school, even one in the poorest part of the Metropolis.'

We cannot now enter fully into the question which engaged the attention of the Board at the meeting to which we referred in our opening sentence. Roughly speaking, however, it seems to us that the qualifications of a candidate seeking admission into one of our training colleges should be threefold: physical, intellectual, and moral. Of the first the medical officer quickly disposes; the scholarship list determines the second; and we sincerely hope the day is far distant when the authorities of the different colleges will not be allowed to make searching and thoroughly satisfactory enquiry with regard to the third.

We rejoice to know that the heads of our normal institutions are not ashamed to own that it is their earnest endeavour, not only to turn out skilful teachers, but Christian men and women, who shall set an example in their lives worthy of all emulation.

We trust Mr. Stanley's proofs will speedily be forthcoming, or that he will for once own that in his eager desire to help the weak, and to secure fair-play for all, he has lent his ear to the malicious wailings of an individual unworthy of his aid.

—o—

Publications Reviewed.

*** We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers whose name and address we will gladly give.

Lectures on Teaching. By J. G. Fitch, M.A. Cr. 8vo, 436 pp. London: Cambridge Warehouse, 17, Paternoster Row.

THIRD NOTICE.

In the next lecture Mr. Fitch dwells on the importance of the study of language. He shows that our 'Grammar Schools' have failed to secure for the vast majority of their pupils anything like a 'classical education.' But, whilst desirous that Greek and especially Latin should be retained in some schools, the lecturer evidently inclines to the opinion that as instruments of mental discipline French or German may serve nearly as well as a dead language, and even that 'you can make the teaching of physical science as fruitful, as thoroughly disciplinal, for all the higher purposes contemplated in a liberal education as the teaching of Greek or Geometry' (p. 397.) We agree with Mr. Fitch that the mental discipline which should be the main result of a liberal education, is due less to the instrument than to the mode in which that instrument is used. Methods of instruction are, in this respect, of more importance than the subjects of study. *How* a pupil is taught vastly outweighs the *what*. But the 'state of things' in our Grammar Schools 'is being slowly mended,' and there is reason to hope that as they are 'modernized and improved' other subjects will 'assert their right to recognition,' and the 'hurtful predominance' of the almost exclusive study of Latin and Greek will cease. But when Latin *is* taught, Mr. Fitch insists on the constant comparison of its idioms and structure with those of the English language. If French or German be adopted, the conversational method is to be preferred in the earliest stages, but always with the same practice of comparison or contrast. Many practical hints are given as to methods, and, in conclusion, as to selection of masters for teaching the modern languages. These hints are all of great value to many of our readers who are engaged in teaching languages. 'Arithmetic,' says our author, 'deserves a high place in our educational system, mainly on the ground that it is to be treated as a logical exercise, and relatively to the needs of a beginner is, as a science, just as valuable as the higher mathematics to a university student.' In the tenth lecture arithmetic is treated as an art, 'an instrument for the solution of problems'; and in the eleventh its scientific use 'as a

means of calling out the reasoning faculty' is separately discussed. Most valuable hints are given in both chapters, the mere enumeration of which would occupy too much space. The author insists upon the general principle 'that the nature of each process should be made familiar by oral exercise before recourse is had to pen or pencil at all,' and he gives by way of contrast an example of 'working by rule'—a process which 'will do more to deaden than to invigorate the thinking faculty of any one who practises it.'

We quote an opinion which is of practical value, that 'it must not be set down as a fault if a child at first counts with his fingers.' Some examiners entirely forbid this practice. We agree with Mr. Fitch. Beginners cannot deal with abstractions. This whole subject of arithmetic seems to enlist the author's special sympathies, and we think he is right in urging increased attention to it, especially where, as in many girls' schools, this 'training in logic' has been sadly neglected.

'Geography and Fact-lore' is the subject of the twelfth lecture. Thoughtful teachers feel that physical geography is the basis of all true geographical instruction; and were examination-papers framed accordingly, the injunction to 'connect from the first physical geography with that which is called political,' would be more generally obeyed. The subject is so wide in its range of facts, that the study of topography resolves itself into one of selection, for we cannot say with reference to any centre that the facts 'diminish in importance as the square of the distance.' 'We should begin with what is known and what is near,' and the ideas thence derived should be gradually extended. In the development of this plan it is shown that 'Geography' may 'be a really educational instrument.' But Mr. Fitch has 'observed that this is the favourite subject often with the worst and most mechanical teachers,' who can present a 'maximum of result with a minimum of intellectual effort.' Nevertheless, the most skilful teachers may find scope for the exercise of their highest powers in connection with geographical lessons, the purpose of which should be 'to increase the pupils' interest in the world in which they live, to awaken their observant faculties, and to help them to recognise the order, the wealth, and beauty of the visible universe.' Suggestions are offered under this head which must be very useful.

The chapter concludes with some remarks on 'Fact-lore,' instruction in which (by means of object-lessons, etc.,) should be given on a definite plan and subserve a scientific purpose. The value of such lessons can hardly be overrated, for, in addition to the 'fact-lore' acquired, the correct use of words and an increased available vocabulary must result. We are glad to find that the Proposals for the Code, 1882, indicate a desire to foster this kind of knowledge in the elementary schools of the country.

For the teaching of History, Mr. Fitch in his thirteenth lecture especially urges that the text-book 'be treated as supplementary and wholly subordinate to oral lessons,' or, if used in the class at all, that it should 'be read aloud, explained, amplified, commented on, and made vividly interesting'—an alternative which, except as to order of thought, amounts to nearly the same thing. Picturesque verbal descriptions demand on the teacher's part a great knowledge of detail, but to the learner such lessons are invaluable. When the 'events' and their relations are 'seen' 'chronology' is necessary, and certain modes of assisting the memory of dates are discussed with advantage. The usefulness of biographical studies and of historical readings in 'kindling a strong interest in the subject' is pointed out by Mr. Fitch, who in conclusion urges the addition of special lessons on the English Constitution and the duties of citizenship, and the cultivation of the spirit of patriotism.

Natural Science is the last subject of instruction treated of in this series. The lecturer asserts for it a proper claim, not only on account of its 'practical usefulness,' but also because of 'the extreme beauty of the truths themselves.' To its disciplinal power we have already referred as compared with that of the study of 'the classics.' The processes of mind required are precisely those which are needed in all the intercourse of life—temper, reserve, breadth of mind, wide observation of details in order to generalization, for it is by the inductive process that men form the principles on which they reason and act. After naming the obviously practical value of Natural Science to our artizans and to the nation in changing mere 'hands' into intelligent workers, Mr. Fitch gives good advice on Trade Schools, and insists on the paramount importance of so teaching children that they shall 'be made observant and intelligent.' Every one will accept this result as far preferable to a mere acquaintance with the terminology of one or even of several branches of Natural Science.

The concluding lecture briefly reviews the whole course under the title of 'The Correlation of Studies.' The reader is reminded that a 'good teacher seeks to give to each class of faculty a fair chance of development'; and, in opposition to the maxim, *Non multa, sed multum*, is asked to believe that—

> 'A pupil who leaves school, knowing only one language besides his own, and having learned it by comparison with his own, knowing also one branch of mathematics besides arithmetic, and one branch of Natural Science, is better educated—better fitted to receive all the subsequent knowledge which the experience of life may bring, and to know what to do with it, than the classical scholar, the mathematician, or the scientist pure and simple.'

Mr. Fitch, however, does not contend for 'many subjects' of study, but, on the contrary, advises the succession of branches of a cognate character, in order that unity of purpose may be maintained as well as a regulated harmony in all its parts, prolonged attention being given to a particular study occasionally. At school there is rarely an opportunity, and no attempt should be made, to develope special aptitudes. Industrial schools may be adapted to such experiments: but ordinarily special tastes should be consulted *after* leaving school.

But we must go no further. Zealous young teachers who look to the future will avail themselves of such help as these lectures afford in perfecting their knowledge of principles and methods of school management. With increased experience they will be the more ready to agree with the author that—

> 'A school is a very unsatisfactory institution, and fails to fulfil its highest function, if, however it may succeed in imparting knowledge, it does not also succeed in imparting a thirst for more, or at least a dawning sense of the inward need for mental and spiritual cultivation, whether such cultivation bears any visible relation to success in life or not.'

And with a sense of his responsibility, but under a consciousness of a vocation to his work, the teacher

> 'Will ever possess within him one of the strongest of all motives to action; for while he is doing his work, he will habitually recognise, and will teach his scholars to recognise, the unseen presence in their midst of One who is the Helper of all sincere learners, and the Teacher of all true teachers.'

School Management and Method in Theory and Practice. By John J. Prince. 2nd Edition. John Heywood.

An interesting and hopeful feature of Education in England at present, is found in the increasing attention which is being directed towards perfecting our system of elementary education. Professors Bain and Robertson, with Messrs. Spencer and Sully, have devoted much thought upon the theories and practice of Education. The Universities are ready to reward the earnest student of the art and science of education with diploma or certificate. Inspectors of schools, notably Messrs. Fearon and Fitch, have also given the results of their wide experience. Amongst elementary teachers a few have ventured to add their practical knowledge to the general store. The present volume is evidently the work of one who is practically acquainted with the teacher's craft. Viewed as a summary of rules and devices for obtaining successful results, the present work contains a large array of such rules—empirically stated, well

arranged, but badly expressed. The book makes no pretence at originality of treatment; the chief aim, as stated in the author's preface, being to supply those who wish to compete at the various Government examinations in school management, with the material needed for such tests, and also 'to accustom them to the manner of answering the questions.'

Pupil teachers, as well as student and acting teachers, have of late been frequently ridiculed in blue books and the daily press, for the crude mode of expression adopted by them in answering questions. The author of this book offers his aid to all who in future intend submitting themselves to inspectorial criticism. The following selections from the first pages of Mr. Prince's book afford specimens of composition which the teacher of the future will do well not to imitate :—

'Knowledge is not the only requisite required at that time (preface).

'Each finds that if he can only make progress in one subject it is recognised, and is raised accordingly.

'His mind, judgment, and spirit are thus laid openly before them.

'If a scholar does anything that is not what he ought to do.'

In the short chapter on Reading, we have the various methods of teaching to read, enumerated, with a brief statement of the advantages and disadvantages of each method. Pupil teachers are further instructed how to conduct reading lessons in the standards I. to VI. This is perhaps the most valuable chapter in the whole book; it is, however, completely marred by the following slipshod or erroneous expressions taken from pp. 80 to 88:—

'These three stages fulfilled, and the stops indicated as pointed out by commas, etc., results in correct reading, as any one listening would be put into as good a position as the reader.

'Occasionally, as an alternate, the scholars may be required to give an abstract of the lesson.

'Before commencing reading tablets, or books, the first thing to teach them is the words in another form.'

Two or three years ago the following question was set in the teachers' certificate examination :—

'*By what arguments would you impress upon children the evils resulting from (a) wanton mischief, e.g., throwing stones at telegraph wires, etc., (b) petty thefts, (c) bullying?*'

After dealing with the dishonesty involved in injuring that which does not belong to us, and stating that dishonesty leads to distrust, the author, in answer to this question, says :—

'In the case of the telegraph, the damage caused by the stone striking the wires or pots is an expense, and money is required from somewhere or someone to repair the damage. Damage might even be done to such an extent as to prevent the proper working of the wires, causing more serious consequences than the boy would ever think of.'

We question whether a wantonly mischievous boy would be seriously impressed by such arguments as these. One of the students for whose benefit Mr. Prince has written this answer has been highly commended by the Inspector who examined these papers for the following answer :—

'First I would give a lesson to the school on the electric telegraph. I would strive to arouse the interest of the children in the delicate mechanism by means of which they could communicate quickly with distant friends. One of the boys might be allowed to send a message to another boy. I would then show how easily it might be damaged, and by these means endeavour to enlist the co-operation of the class in the protection of the telegraph wires.'

We certainly prefer the answer given by the student to that suggested by his self-constituted instructor.

In the chapter on Writing, all goes well until an attempt is made to write the word 'MANAGEMENT' in Mulhaüser's Rhomboids. Let this specimen of writing be compared with those in *The Manual of Writing* published under the sanction of the Council Office, 1849, and almost every letter is faulty in construction. The class subjects are taught on sound methods, but why refer to Macmillan's Science Primers for the method of teaching the *Seasons?* Can this subject be taught Standards II. or III.? What is the result of the author's experience? We should like to know. The preface states that all the methods herein advocated 'have been *tried, tested*, and proved successful."

What amount of success would follow the attempt to teach a junior class the following for a first lesson in grammar :—1. Sentence. 2. Names of things. 3. Names of qualities. 4. Names of actions. If these form too much material for a first lesson, what is to be said of the 'Notes of a first lesson on a noun,' pp. 218 and 219, in which, 1. The definition of a noun. 2. Kinds of nouns. 3. Definitions of proper noun, common noun, and abstract noun are all to be taught, written on the black-board, and then committed to memory by the children; and as a conclusion to the lesson, the class is to write out all the proper, common, and abstract nouns from a page of an ordinary reading-book in columns on their slates.

We hold that in this lesson there is ample material for at least half-a-dozen lessons to those beginning the subject.

The book will be of service to head teachers, who are able to select what is good, but it should not be put into the hands of pupil and student teachers.

Latin Grammar and Composition for London University Matriculation. By William Dodds. 68pp. London: W. Stewart.

It is very amusing to note how every cram author begins his book with an earnest protest against cramming, after vigorously enunciating which, he will proceed to inform you that though all previous geniuses who have tried the style, have fallen into this pernicious vice—here again will come a neat little selection of adjectives describing the detestability of cramming—his book is entirely free, *his* intentions being purely and simply the welfare of the student. Mr. Dodds is too old in the trade to make all these statements at once, and yet, even with his vast experience, cannot refrain from the following admission, made with charming frankness :—'The present treatise is intended to be used with, and not in the place of, text-books; our object being rather to guide and direct, etc., etc., and to throw in such useful hints and suggestions as an experienced tutor, placed at his elbow, might be supposed to give him, etc. etc.' Now, Mr. Dodds knows very well that although he does thus inform the student of multitudinous praiseworthy desires on his part, said student will not give him a word of thanks unless the book shall have succeeded, where all others have some nineteen or twenty times failed, in getting a 'scrape second.' Mr. Dodds knows also that if the student were plucked, one probable result would be the burning of 'Matriculation Latin' in sheer disgust; and if he passes, a very possible result would be the same fate for the book, this time in sheer disdain. It would have been an excuse, we admit, if the London Matriculation Latin, which, it would seem, is an utterly distinct thing from Cicero's Latin, possessed any special merits of its own. But the authorities in Burlington Gardens have not unfrequently been known to be beautifully indefinite. Their questions now and then resemble a notable query on Scripture History which we once heard an Irish examiner put to a class too dull to recognise, even if they ever knew it, the episode of Benaiah and the lion, 'Who killed what on a snowy day?' This being the case, such a collection of questions as the present can scarcely demand permission to stand on their own merits.

But let us look for a moment at our author's pretension to help the student in his reading. As a logical consequence, from this pretension we must form one of two conclusions—either that all previous books were unadapted for reading, or that they contained *too much* for the Matriculation. The first conclusion is *a priori* absurd, while the second is indeed pitiable. For what does this second mean? Cramming, in the essence of it, and cramming the less excusable and the more dangerous because so ingeniously cloaked.

We must not, however, be understood to hint that Mr. Dodds' part of the work has been done in a journey fashion. On the whole it is carefully compiled, and with one or two striking exceptions, correctly. Now and then, as we might expect, the English is simply not English. This,

however, is fast becoming the rule with educational books, and is therefore partially excusable by precedent. But cannot Mr. Dodds see that his system will inevitably ruin just those whom it was intended to help, while it would do no harm to those whom it will never reach? Poor struggling workers who aspire to Matriculation may possibly be helped in a lame fashion to the object of their aspirations, but are they a whit the better for it? A life-buoy is very useful, indeed, to keep people from drowning, but is scarcely a good teacher of swimming.

Punishments in the Olden Time. By William Andrews. London: Stewart and Co., Holborn Viaduct.

Modern educators seem averse to punishment, at least to most kinds of bodily pain inflicted with a remedial design. Many regard the practice of former days as spoiling both the rod and the child, and altogether public sentiment would not now countenance the severities of the Busbys of a former generation. In dealing with adults, the law has been gradually and persistently relaxed up to the middle of this century, when the unusual prevalence of garrotting and similar dastardly outrages, induced the legislature to re-enact a modified return to the lash. Nearly all implements of pain or bodily confinement are now abandoned, including the village *stocks*, pretty well remembered, but very seldom to be seen, and certainly never used. Some thirty years ago, the stocks of the royal village of Kew were kept in good repair, but being left unlocked, the upper part was wrenched off and cast into the Thames. Nothing was done to repair the injury, and the other portions were at once removed, and are now almost gone from remembrance. Other old-fashioned engines of punishment have shared the same fate, and are now and then preserved as relics of the past. The brank, a framework of iron for the head, and having a cutting projection that was placed in the mouth to prevent the tongue being moved, is preserved in the vestry of Walton Church, near Weybridge, and bears the date of 1633. The preservation of such horrible implements teaches us that we have indeed made some progress, notwithstanding our shortcomings, and that a poor miserable woman, whose sole offence consisted in raising her voice against a brutal and besotted husband, was led by the parish beadle, with this iron cage upon her head, to the pillory, whipping-post, or market-cross, there to be subjected to every insult and degradation. Mr. Andrews has taken the pains to collect and give drawings of many of these implements of torture, some of which are of fiendish design. It may show the spirit of barbarism that formerly prevailed by the fact that several of these disgraceful implements were for the maltreatment of women. Of this the ducking-stool, of which one remained up to a comparatively recent date at Broadwater, the mother-parish of Worthing. The drunkard's cloak was among the least painful of all; it consisted merely of a tub, or cask, with holes at the sides for the hands to project, and also one on the top, above which the head emerged. The most common of these implements of punishment, however, was the pillory, provided by law in most corporate towns. This means of punishment was not removed from our statute-book till the year 1837. Among the most noted personages placed in the pillory were the infamous Titus Oates and the famous Defoe. The latter obtained the sympathy of the populace so as to be pelted with the complimentary missiles of flowers! Another notable name associated with the pillory is that of Benjamin Keach, a predecessor of the Rev. C. H. Spurgeon, who was put in the pillory for publishing 'The Child's Instructor,' a little primer! What a change has taken place regarding education! Mr. Andrew's book is carefully compiled and suitably illustrated.

How to Teach the New Testament. By Charlotte Mary Yonge. London: National Society.

This little book forms one of the 'Religious Knowledge Manuals' of the National Society. Miss Yonge has an evident sympathy for children, and knows how to win their attention as well as their affections. The spirit in which her directions, or rather suggestions, are made, is admirable and free from the dogmatic tone which teachers of religious lessons frequently adopt. Her object is wisely to imbue little ones more with the spirit than the letter of Scriptural lessons. Her course for infants is judicious, and the little specimen lesson admirable. But we question the wisdom of learning 'by heart,' as it is called, a great number of hymns—in fact, some verses to every lesson. Doubtless, the memory of infants may be occasionally exercised, but only occasionally, and far less, we think, than is generally done. But the learning of even one verse together with a portion of a hymn is more than should be exacted from little children. The use of pictures and other means of engaging the attention is wisely recommended, and the advantage thereby derivable pointed out in the course of the specimen lessons. This learning by heart is so highly regarded by Miss Yonge that she recommends 'If possible, the Sunday Gospels should be learnt by heart; but if any other plan be adopted, this age (that next to the infant period) is a suitable one for making the children learn the Parables and the Sermon on the Mount.' We hope some other plan will be adopted than this 'making' of children do any thing of the kind. The wondrous beauty and simplicity of the Sermon on the Mount will involve no oppressive effort on the memory, but we should hesitate in taxing the powers of young children to half the extent thus recommended. Most cordially do we agree with the authoress as to the value of good poems in giving zest to a lesson to children of both sexes and all ages, who 'will listen to them with great pleasure, and carry off an impression far more vivid than if left to the teacher's endeavours at description.' Most true, and of course not to be understood as discouraging all efforts at explanation on part of the teacher, but making such efforts effective by the highest truths being expressed by the best writers in the best way. The higher course of teaching the more advanced scholars is thoroughly developed by Miss Yonge, and her explanations of the various points of the Gospels and Epistles, together with the course of teaching suggested, most ably and carefully shown. The devout, yet loving spirit of such a teacher as Miss Yonge, cannot fail to win the heart as well as to stimulate the intelligence of every pupil who is benefited by such efforts. Those who carry out—and the work involves much reading—the course recommended by the authoress cannot fail, if working in a proper spirit, of becoming useful and, we hesitate not to add, *good teachers*.

We are sorry to notice that one of the reasons urged for the teaching of infants in Church Schools, is lest they should go to schools conducted by Dissenters. We say nothing on the exceptionally bad taste of such a remark, beyond expressing our regret that it should have been made.

Great Englishmen: Short Lives for Young Children. London: George Bell and Sons.

The rather awkward title we thought might be amended to 'Short Lives of Great Englishmen,' and with this our disposition to find fault ceases. The sketches of about a score of the most famous Englishmen are simple and explanatory—being thus adapted to junior readers—yet remarkably well done; in many cases the description rises to true eloquence that is none the less effective though couched in a simple style. The descriptive details are well relieved by occasional dramatic touches, such as the following on Caxton:—'Caxton worked on till he was nearly eighty, and he worked up to the day of his death. He was not slumbering when his call came; he was still labouring at the work for which he was born. . . . . It was eventide, and the sun was sending its last red streaks of light into the little workshop of Westminster, when four workmen entered, clothed in black, and looking grave, sad, and downcast. The room looked deserted; papers lay about; the ink-blocks were dusty;

a thick film had formed on the ink; the machinery looked oily and unused. The four men drew in their stools on which they had sat through many a long day of quiet labour, steadily working to the distant end of some manuscript—working for their master, who would now no more direct their work and encourage them to the end.

'"Companions," said one, "this good work will not stop."

'"Who is to carry it on?" sadly asked another.

'"I am ready," answered the first speaker, whose name was Wynkyn de Worde.

'A cry of joy rose to the lips of the honest workmen, but it faded again as they thought of him they had lost.'

Equally affecting is the brief sketch of the death of Harold, 'who had made himself very dear to his people, and spared no pains to make them happy':—'Harold, the son of Earl Godwin, the last of the Saxon kings, the man who died fighting for the land and the people he loved so well, was buried beneath a heap of stones on the "waste sea-shore." For "he kept the shore while he lived; let him guard it now he is dead," said William. And the English wept long and bitterly for their king.

'"Oh, Harold, Harold!
Our Harold, we shall never see him more!"'

The stories of Nelson, Wellington, Stephenson, and other worthies are told equally well. Our only regret is that we have no more room for quotation. Much in the way of history will be most strongly impressed on the memory by the reading of this book, and its effect on the minds of youthful readers cannot for a moment be doubted.

An Easy and Rapid Method of Acquiring a Thorough Knowledge of the Latin Verbs. 48 pp., sewn. Glasgow: David Wilson.

We confess we were under the impression that no rational being could find a difficulty in his Latin verbs, but we fear we must abandon this long-cherished notion in favour of our anonymous author's proposition that most boys do. Admitting even this, we cannot see the necessity for the present book. We are sorry in any case to give this verdict upon a humble little work that can do no one any harm, but particularly when it is so carefully prepared as the present. There is no novelty in the arrangement, no particular attractiveness in the details. We plod through our terminations, the twenty-third page sees us actually at work; the thirty-sixth page lands us at irregular verbs, and the five last pages are a list of anomalies. The chief merit in the book is that this list of anomalous verbs is arranged anyhow, so that the learner cannot learn a verb by its position on the page; the chief defect is that nothing is said about compound verbs. It would not be hard to pick out defects, but this almost goes without saying, considering that there are some verbs upon which no two Latin grammars agree. On the whole we doubt the general soundness of a principle which supplies the student with note-books and 'Short and Easies,' or 'Easy and Rapids.' No notes are worth having unless compiled by their owner.

The Kindergarten. Being a selection of Lectures read before the London Froebel Society. London: Swan, Sonnenschein, and Allen.

We must plead ignorance to much connected with teaching children how to play on scientific principles, and telling stories to them with some profound æsthetical or symbolical meaning in our words or tales. We confess also to be as completely bewildered at the sight of the recondite design, nicely packed, like one of Mr. Murray's maps, in a sort of sheath inside cover of the book, which reminded us of the mystery of a Freemason's apron. Our early efforts, as in teaching, were mainly directed to keep little children from playing and induce them to attend to our less attractive books and lessons. In all this we were doubtless wrong, and should have possibly avoided such errors had we been taught 'Jack and the Bean Stalk' on the Kindergarten principle. And now having made this honest avowal, let us speak of the great pleasure we experienced in reading the essays in the book before us. Miss Emily Shirreff, whose admirable educational essays we remember,* begins this book with paper on 'Progressive Development.' In this we realized the force of the writer's remark, 'To few is it given to reach these serene heights;' and not being one of those few who see much difference in letting little trots make mud-pies or lumps of clay into spheres or into cubes—*i.e.*, into marbles or into brick-bats—we left this *arcana terrestria* to ponder over the many plain and excellent educational suggestions contained in this and the other essays. Among these, Miss Hoggan gives many admirable hints on the physical education of girls. In this a reform in dress is, we rejoice to say, insisted upon, especially in avoiding compressing the waist, and the modern monstrosity of high-heeled boots. Exercise for girls is no less wisely shown to be essential to health, and also wherein it should differ from the more violent efforts which boys may undertake with impunity. We regret that we have no space also to allude now to the thoughtful paper by Miss Buckland on 'The Happiness of Childhood,' but hope to allude to this before long. The following will be suggestive to every thoughtful teacher:—'God only teaches what the mind can receive; Christ, the Great Teacher, reserved the most important truth until His disciples could receive it; but the minds of little children are often loaded with a mass of unintelligible religious teaching, beneath which they shrink oppressed and discouraged. It is this forcing of everything at once upon a child before he can grasp it, that often makes religious teaching a misery rather than a joy.' Again—'Let the thought of God be first associated in the mind of a child with all the good gifts and blessings of life, but not with its catastrophes and terrors. A little child was told that the thunder was the voice of God, and this at once provoked the remark, "Then I don't love God at all, and never shall." Too often the representation of God to little children has been such as to produce fear and misery, rather than love and happiness.' We fear that we have all much to answer for in this way, and hope we have said enough to show how worthy of attention this little book is, whether we mould our lumps of clay into round balls or 'on the square,' as the song saye th.

The Canal Boy who became President. By Frederick T. Gammon. London: S. W. Partridge.

Few books are more deservedly interesting to all connected with education than the above, which traces the course of the lamented President Garfield from the cradle to the grave. Most readers are acquainted with the main features of the life of this distinguished man, from the numerous newspaper accounts which his illness and death called forth. The life, however, of such a man cannot be too often told, and in the little book before us it is well told. Although called the canal boy on account of his youthful employment, yet James Garfield was mainly celebrated for his success as a student, teacher, and classical professor of the Hiram Institute, of which he was soon elected President. Here he taught and ruled over 300 students with signal success. One of the students speaks of the 'admiration and love' felt for Professor Garfield as having 'never abated, and the like of which I shall never know.' Schoolmasters may well be proud that a man altogether so pure and worthy belonged to their class. He gave up literature to enter upon a military career at the fierce contest in 1861. As a soldier his success was no less marked than his collegiate career, and on being raised to the rank of major-general, he was elected to a seat in the Congress at Washington. His military knowledge and general ability were regarded as indispensable to the government of President Lincoln, and thus General Garfield became famous as a states-

* Especially an excellent collection of essays entitled, 'Why should we Learn?'

man. His success as an orator and administrator are well described by Mr. Gammon, together with the touching scenes of his lamented death. We have thus indicated a few of the leading incidents of the career of this self-made man, with the desire that Mr. Gammon's well-written narrative may be extensively read.

Walker's Elementary Atlas of Modern Geography. London: John Walker and Company, Farringdon Street.

This little sixpenny atlas contains sixteen coloured maps, one of which is a remarkably useful one of the physical features of the British Isles. In this the plains—in light yellow tint—are seen at a glance, as well as the hills (light blue), and the granite formation in red. We could wish the tint of the mountains were more distinguishable from that of the sea: these being identical give an impression of the sea penetrating inland—in fact, where the mountains are situated. Good use is made of the covers, each page of which contains useful explanatory diagrams.

A Poetical Reader; (Longman's Modern Series.) For the Fourth Standard of Elementary Schools. Selected by James Booth. London: Longmans, Green and Co.

This well-printed and beautifully illustrated book of poetry contains a goodly selection of old favourites by Milton, Campbell, Scott, Burns, Byron, Goldsmith, Macaulay, and other leading authors, together with several modern ones of unquestionable merit. These latter include Hood's 'Dream of Eugene Aram,' now justly regarded among the classical gems of English poetry; a spirited description of the Queen's receiving the news of the fall of Sebastopol, Kingsley's 'Three Fishers,' Douglas Jerrold's touching lines entitled 'The Drum,' some beautiful verses on 'Sir John Franklin,' and several equally meritorious pieces by anonymous authors. The entire selection is marked by good taste and appropriateness to the higher pupils of elementary schools. Generally, the pieces are of a serious, many of a deeply pathetic character; but these are relieved by a few humorous ones selected with equal care and judgment. A few brief explanatory notes are appended, and a short biographical introduction placed at the beginning of the known authors of the extracts that follow. The illustrations are plentiful, appropriate and remarkably good. Few better specimens of wood engraving can be found than many that grace this little collection. Among the most beautiful of these is that of the Bell Rock Lighthouse, the simple yet wondrous curling wave and watery expanse at the head of Byron's lines on the ocean, the view of Dover, and more particularly an exquisite little picture of a soldier dying in the snow, while his comrades pass mournfully on; the snow weighing down branches of the tree over the fallen soldier's head is most effective. Very sweet and also suggestive is the heading to Milton's 'L'Allegro,' representing a milkmaid bearing her pail on her head, and at the side a shepherd counting and penning his sheep under a tree, thus aptly suggesting the explanation of the well-known, but often misunderstood lines:—

'And every shepherd tells his tale
Under the hawthorn in the dale.'

For elementary schools the book should be more strongly bound.

Ludgate Hill: Past and Present. By W. P. Treloar. London: Griffith and Farran, St. Paul's Churchyard.

Mr. John Bright, in his recent speech at Rochdale, said that he had lived in London for six months in the year during the last forty years, and yet knew nothing of the great metropolis. We venture to say if he will read Mr. Treloar's book that he will learn therefrom something about Ludgate Hill. Pleasant reading, too, withal, and by no means dogmatic. Mr. Treloar introduces us to the mythical King Lud, whose effigy—together with that of a son on each hand—was pulled down with the rest of the structure of the old prison in 1760, after being stowed away for some years in the bone-house of the adjacent St. Dunstan's Church, was taken away by the Marquis of Hertford (Thackeray's Marquis of Steyne) to his villa in Regent's Park. From this shadowy period we are taken through what vestiges remain of Roman London and the very few British features. Saxon London was, as Mr. Treloar remarks, 'Roman London despoiled, but growing yearly richer in the commerce planted by the former invaders.' The truly dark period that marked the struggles of the early Teutonic settlers was ended by the introduction of Christianity, followed by the cohesion of the Heptarchy into the single Government of Egbert. London continued to make progress, though slowly, till the advent of Canute, who greatly improved and strengthened the place. When the Normans came, London was fully entitled to be looked up to as the metropolis of the kingdom. We are then led by Mr. Treloar through Bridewell, and among other notable surroundings of this central part of the old city, giving us snatches of history where suitable, and instructive gossip that is by no means out of place. Of course, much of the general history of London is dipped into in accounts of the Churches of St. Paul; the River Fleet and its prison; the Great Fire and the Plague; the establishment of the booksellers in Paternoster Row after the Great Fire, when this locality was created by the mercers, lacemen, milliners, and tire-women. We are treated to a view of Ludgate before the removal of the prison on the spot now crossed by the ugly railway-bridge; next to a picture of Ludgate Hill towards the latter part of the last century; and finally, by way of frontispiece—if we may so express it—of the Hill crossed by the said hideous railway-bridge, across which a locomotive in full steam is seen. Much more we would add to express the pleasure this book has afforded us.

A Glossary of Biological, Anatomical, and Physiological Terms. By Thomas Dunman. London: Griffith and Farran.

To students of botany, physiology, and general science, this Glossary will be most welcome. It contains a goodly number—161 pages—of scientific terms, boldly printed so as to attract the eye, accentuated for pronunciation, and alphabetically arranged. These words, after being traced to their Greek or Latin sources, are explained concisely, yet sufficiently for all purposes required by the student. This book will save the student much trouble in tracing scientific terms, and also save many scientific text-books from being encumbered with such explanatory verbalisms.

The Boy's Own Toy Maker. London: Griffith and Farran, St. Paul's Churchyard.

While we are straining our wits how to teach and what to learn, we should do well not to neglect the teaching of how to play. Boys and girls teach each other much in the way of games and sports, it is true; but even then the old adage holds good that all must have a learning. It is mostly in the way of teaching boys and girls how to amuse themselves indoors during winter evenings as well as out of doors with kite, bat and ball, angling, and the like, that this little book is written. In it we have directions how to make good use of a pair of scissors and a sheet of paper. Add to these a sheet of cardboard and a bottle of gum or glue, and wonders may be wrought in the way of rustic cottages, boats, puzzles, and an endless succession of toys whose symmetry is much secured by their being cut in a duplicate or folded position. Add a few tools, including a fret-saw, and a new sphere for ingenuity is opened. With a few inexpensive and harmless chemicals many interesting and truly instructive experiments may be performed, as the little book before us explains. The process of producing copies of wax impressions in electrotype may be carried out with the aid of very simple apparatus. By equally inexpensive and simple materials the field of

optics, electricity, and other physical sciences may form matters of common employment for leisure evenings. We say nothing of the knowledge of science thus to be gained. Indeed, we would rather keep this out of sight. It will make its own way most surely, and perhaps the more so by the object being understood to be that of amusement. The directions given in this little volume are clear, and easy to be understood. Who can doubt but that a taste for intelligent skill will be developed by inducing amusements of the kind herein described? Many old numerical and other puzzles, such as the nun's expedient to make up the number nine on each side of the square; the puzzle of the two fathers; puzzles double; puzzles single; puzzles with glasses; and puzzles with coins: all suggesting, or capable of being made suggestive, of some philosophical principle. Surely by such means idle or worse kinds of play may be eliminated.

Hofer, the Tyrolese. By the Author of 'Claudine, etc. London: Griffith and Farran, St. Paul's Churchyard.

The character of Hofer has suffered not only from the acerbity of the French, but from the petty jealousy of Austrian writers. But the purity of his life and persistent devotedness in defence of the liberties of his country have been very generally acknowledged, and are in this affecting little narrative cleared from all shadow of stain. The abandonment of the brave patriot and the people of the Tyrol by the Austrians was the main cause of the success of the French. But Hofer yielded not, nor would he have been taken but for his determined efforts to rescue his beloved wife from the hands of his enemies. These efforts led to his betrayal to the French. Napoleon was not the man to forgive so successful a patriot. Hofer was condemned to be shot, and no stain is greater on the name of Napoleon than this *murder* of Hofer. True his name lives in the Tyrol, as that of Washington does in America. 'Justly,' says the writer of this little sketch, 'is he regarded as the saviour of his country.' The struggles, victories, and exemplary conduct in restraining excesses are described by the author with remarkable power, considering the condensation of the narrative. At the famous battle of the 12th of August—the Bannockburn and Bunker's Hill of the Tyrol—the Bavarians were alarmed while in the defile of the Isel Mountains at the sounds of a voice from the heights above. 'To return was impossible, to halt was madness—all rushed forward. Once more the deep silence of the terrified assailants was broken by two simple, but appalling words—"For Tyrol." For an instant all was deadly stillness: the appalled enemy gazed on each other with pallid cheeks and haggard eyes. Another instant, and rocks, trees, and stones are wrenched from the borders of the ravine, and fall upon the foe with overwhelming force. From behind every cliff and bush starts forth an armed Tyrolese. It is a pursuit, and not a battle; a flight, and not a combat. Boys and girls join in driving the enemy through the pass. Hundreds were taken prisoners; thousands slain. When the victory was completed the mountaineers fell on their knees, and returned thanks to God for the deliverance of their country. So awful and so sudden had been the work of extirpation that the bewildered prisoners joined in the act of prayer!' These are stirring words, and by no means exceptional to the spirited narrative before us. The facts are stated on the authority of Kotzebue's narrative and the 'Edinburgh Annual Register' for 1810.

Peter the Whaler. By W. H. G. Kingston. London: Griffith and Farran.

No book written by the lamented Mr. Kingston has become more worthy of popularity than *Peter the Whaler*, of which a copy of the twelfth edition is now before us. We need say nothing in regard to the merits of Mr. Kingston's ever-fresh and ever-welcome books. He had the knack of keeping up attention without sensational excitement. His narratives are natural yet interesting, and the moral never unduly thrust forward. Messrs. Griffith and Farran have clothed this edition of Peter's adventures in an attractive binding.

A Gem of an Aunt; A Story in Short Words. By Mary E. Gellie (M.E.B.). Griffith and Farran.

Mistress Mary E. Gellie laid out for herself no slight task in undertaking to tell a sustained tale in monosyllables. The same feat has been successfully accomplished by Miss Sarah Crompton, of Birmingham, in her story of Robinson Crusoe, and by others. To the list of successful books for very young readers we must add the volume before us. This opens with a call from Aunt Bell, and an offer on her part to take her nieces and nephews, a little group of five, to the seaside. The offer being, of course, accepted, we have a pleasant record of the holiday, of the young folks' delight at the sea, and their little adventures in country excursions, with pleasing descriptions of country objects and scenes. We have a fair supply of little tales by way of relief from Aunt Bell herself, who winds up with a very pretty story of 'The Twins.' We will not mention the word lessons in relation to this nice little book, but its words and ideas are within the scope of young beginners, who, we doubt not, will be charmed to have the paths of knowledge made thus smooth and attractive.

Poetry for the Young. 128 pp. London: Griffith and Farran.

The only fault (and we own it is a very pardonable one) we have to find with this book is the binding. Doubtless the publishers thought this volume would command a special sale as a prize at this season of the year; we hope it may. But for the ordinary wear and tear of school work, it certainly should be clad in a more serviceable dress. Of the book itself, we have no complaint to make: the selections, type, and paper are admirable. We do not think any teacher who buys 'Poetry for the Young' will regret his investment.

Our Little Ones. Vol. II. No. 1. London: Griffith and Farran.

If we are not mistaken, this is an American periodical, re-issued in the mother-country to find favour in the eyes of her little folk. The illustrations, which, to many children are the chief attraction in a book of this kind, are faultless, and (we are sorry to have to make the confession) put into the shade the workmanship of our best English houses. The literary work is also well done. 'Our Little Ones' is sure to be a favourite.

Our Little Ones. No. 2, vol. II. Griffith and Farran, London.

This number is illustrated with care, taste, and in point of merit is not behind its predecessors.

Rhymes in Council. Aphorisms Versified. By S. C. Hall. London: Griffith and Farran.

'In the eighty-first year of my age I write these verses. They are the outcome of knowledge, based on experience, and matured by thought: the proceeds of *a long life*.

'A few dotted down reflections have grown into a book.

'I bequeath them as a legacy to my kind—with humility, but with faith, hope, trust, and love.

'May they, by the aid and blessing of God, bear fruit.'

So read the opening sentences; and what more need we add except that the worthy veteran has succeeded in his effort. Messrs. Griffith and Farran, in publishing the work, have spared no pains to entitle it to a place on any drawing-room table.

Holly Berries. With Original Illustrations. By J. Waugh. London: Griffith and Farran.

This is a volume of rare beauty, described on the wrapper as 'the gift-book of the season.' Exquisite taste has been shown by all concerned in the production of it. Miss Waugh's admirable drawings are beautifully printed in colours. We hope these 'Holly Berries' will brighten up the homes and gladden the hearts of thousands of our young friends this coming Christmas.

Johnston's First Grade Freehand Test Papers, containing 24 different designs. London: W. and A. K. Johnston.

We have pleasure in drawing attention to these designs, now that the general Drawing Examination will soon be upon us again. The copies are clear, graceful, and progressive. They possess one special merit that should not be overlooked in the country school, where rigid economy has to be practised, and that is, the designs are so arranged that after the book has been filled by the pupil, they can be cut out, mounted and used as ordinary drawing cards. We gladly recommend the book.

Roach's Practical Examiner's Arithmetical Tests. For Standards 2 and 3. London: T. Murby.

These two sets of cards furnish excellent arithmetical test work for the Standards for which they are designed. Each packet contains twenty-four cards and two copies of answers, which are enclosed in an attractive cloth case. The way in which the answers are mounted deserves a special word of praise.

The Analytic Test Cards. In three Packets. By R. S. Wood. London: J. Marshall and Co., Paternoster Row.

These cards deserve to have a wide circulation. Next to arithmetic there is perhaps no subject so unsatisfactorily taught as English composition. To the teaching of this subject Mr. Wood has evidently paid special attention. These three packets of cards, adapted for pupil teachers and the higher standards in our elementary schools, embrace no less than three hundred different subjects. The questions have not been set down haphazard; they are suggestive, comprehensive, and practical. As an instance of the way in which a young beginner is helped, we transcribe the first question on one of the cards now before us:—

'Write all you know of the cotton plant, under the heads (1) The appearance of the plant, (2) *Where* and *how* grown, (3) The cotton-fields, (4) *How* gathered, (5) *Where* it is sent, (6) *How* and *where* it is manufactured, (7) What it is made into, (8) Its *uses*.'

We hope the Analytic Test Cards will meet with the patronage they so well merit.

Longman's Quarterly Arithmetical Tests For Standards 2, 3, 4, 5, and 6. London: Longmans and Co.

These new candidates for public favour present a remarkably neat appearance. On each card there are twenty questions, divided into four quarterly progressive examinations. The advantage of this arrangement must be apparent and commend itself to every practical teacher. The questions furnish the means of testing a child's progress at almost any stage. We heartily commend the series to the notice of the profession.

Universal Instructor. Part 14. London: Ward and Lock.

This periodical is as usual full of valuable matter, and well illustrated.

The Midland Grammatical Exercise Books for Standards II. to VII. Birmingham: The Midland Educational Company.

These books are neatly ruled according to the most recent requirements of the new code. They will ensure neatness of work and save the teacher much trouble. The prices at which they are issued are very moderate.

Agonic-Eyed Needles: Manufactured by S. Thomas, Redditch.

A clever sempstress, who has used these beautiful needles, gives them high praise. They are easy to 'thread,' and exceedingly pleasant to use.

Publications Received.

Arithmetic—

(1) Roach's Practical Examiner's Arithmetic Tests. T. Murby.

Drawing—

(1) First Grade Freehand Test Papers. W. and A. K. Johnston.

German—

(1) Quick's Essentials of German. Longmans, Green and Co.

History—

(1) John's History of England. W. Isbister.

Latin—

(1) Fyfe's Easy and Rapid Method of Learning the Latin Verb. D. Wilson.

Miscellaneous—

(1) Sonnenschein's Foreign Educational Codes. W. Sonnenschein and Co.

Periodical Literature—

(1) Ward and Lock's Universal Instructor. Part XIV. Ward, Lock and Co.
(2) Our Little Ones. No. II. Griffith and Farran.

Prize Books—

(1) Gammon's Canal Boy who became President. S. W. Partridge and Co.
(2) Norris's Early Start in Life. Griffith and Farran.
(3) Robson's River Singers. Bemrose and Sons.

Scholarship Examination, 1881.

MALE AND FEMALE CANDIDATES.

Dictation and Penmanship.

Twenty Minutes allowed for these Exercises.

Candidates are not to *paint* their letters in the *Copy-setting Exercise*, but to take care that the copy is clean and without erasures.

Omissions and erasures in the *Dictation Exercise* will be counted as mistakes.

The words must not be divided between two lines; there is plenty of room for the passage to be written.

Write in large hand, as a specimen of Penmanship the word *Contemplation*.

Write in small hand, as a specimen of Penmanship, the sentence—*Still glides the gentle streamlet on.*

Dictation.

Write the passage dictated to you by the Examiner, and punctuate it correctly.

[We regret that owing to a printers' error the price of the quarterly subscription to the *Schoolmistress* newspaper was quoted wrongly in our last issue. It should have been 1s. 9d. instead of 1s. 3d.]

Query Column.

☞ **As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'**

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not later than the 15th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed

'*The Query Editor*,'
The Practical Teacher
Pilgrim Street, Ludgate Hill,
London, E.C.

Arithmetic.

1. DOUBLE GLOSTER, Cam.—

(*a*) In what time will £400 amount to £467 18s. 10·42d. at 4 per cent. comp. int.?

(*b*) At what rate per cent. will 70 guineas amount to £114 16s. 10½d. in 2 years at comp. int.?

(*a*) £467 18s. 10·42d. = £467·943416.

Amount of £1 at end of required time =
£467·943416 ÷ 400 = £1·1698585416.

Now amount of £1 for 1 year at 4 per cent. = £1·04; and if we multiply this (1·04) by itself until we obtain 1·1698585416, we shall readily see the answer.

$(1{\cdot}04)^4 = 1{\cdot}16985856.$

Hence required time = 4 years.

Amount of £400 for 4 years at 4 per cent. comp. int. = £467 18s. 10·42416d.

(*b*) £114 16s. 10½d. = £114·84375.

70 guineas = £73·5.

Amount of £1 at end of 2 years = £114·84375
÷ 73·5 = £1·5625.

Now $\sqrt{1{\cdot}5625} = 1{\cdot}25$.

∴ Amount of £1 for 1 year = £1·25.
Interest on " " = £¼.
∴ Rate per cent. ... = ¼ of 100.
= 25.

Note.—When the given time is 3 years, 4 years, etc., the cube root, 4th root, etc., must be taken. The 5th, 7th, and similar roots would be calculated by Logarithms.

2. R. B. P.—The expense of constructing a railway is £2,000,000, of which ¼th part was borrowed on mortgage at 5 per cent, and the remaining ¾ths was held in shares; what must be the average weekly receipts so as to pay the shareholders 6 per cent., the expenses of working the railroad being 45 per cent of the gross receipts? (*Barnard Smith.*)

Interest on mortgage = 5% on £500,000
= £25,000.
Dividend on shares = 6% on £1,500,000
= £90,000.
Total amount paid ... = £115,000.
Working expenses ... = 45% or $\frac{9}{20}$ of gross receipts.
∴ Amount paid ... = $\frac{11}{20}$ of gross receipts.
∴ Gross receipts = amount paid × $\frac{20}{11}$.
= £115,000 × $\frac{20}{11}$

$$\therefore \text{Average weekly receipts} = £115{,}000 \times \frac{\frac{5}{26}}{11 \times \frac{52}{13}}$$

$$= £\frac{575{,}000}{143}$$

= £4,020 19s. 6¾d. $\frac{132}{143}$q.

3. R. GIBBONS, Stockport.—I sold a certain amount of railway stock at 106, and invested the proceeds in the 3 per cents. at 96. I sold out this 3 per cent. stock at 99, and repurchasing the railway stock found myself a gainer of 80 guineas. What amount of stock did I originally possess?

£ £ £
96 : 106 :: 3 : Gain on £100 of original stock
32 53
16
= £3$\frac{1}{16}$.

£ £ £
∴ 3$\frac{1}{16}$: 84 :: 100 : Amount of stock originally possessed
16 16
53)134400
£2535 16s. 11¼d. $\frac{4}{53}$q.

4. X. Y. Z.—A person sold out £296,000 in the 3 per cents. at 91¼, paid 5s. per cent. as brokerage on the amount realized, and £54 15s. for other expenses. He invested the remainder in two equal amounts in New Zealand 5 per cents. and Queensland 6 per cents., increasing his yearly income by £5,070. The price of New Zealand Stock was 102½. What was the price of the Queensland Stock?

Income derived from the 3 per Cents. = £(2,960 × 3)
= £8,880
Amount realized for this Stock = £(91¼ × 2,960)
= £270,100
Expenses = ¼% on £270,100 + £54 15s.
= £675 5s. + £54 15s.
= £730.
∴ Net amount = £270,100 − £730
= £269,370

Income derived from the new stocks = £8,880 + £5,070
= £13,950
" " " " New Zealand Stock
= (½ of £269,370 × 5) ÷ 102½

$$= £269{,}370 \times \frac{5}{2} \times \frac{2}{205}$$

$$= £\frac{269{,}370}{41}$$

= £6,570

∴ Income derived from the Queensland Stock
= £13,950 − £6,570
= £7,380

∴ Price of the Queensland Stock

$$= \frac{134{,}685 \times 6}{7{,}230}\,£$$

$$= \frac{219}{2}\,£$$

$$= £109\tfrac{1}{2}.$$

5. NORTH.—The gold coinage of one nation contains 1 part of silver to 11 parts of gold, without alloy; that of another nation 1 part of alloy to 23 parts of gold. It is found that 46 of the second weigh as much as $88\frac{1}{2}$ of the first. The intrinsic value of silver is $\frac{1}{15}$ that of gold. Determine the par of exchange.

Gold coinage of 1st nation : gold coinage of 2nd nation

$$:: 88\tfrac{1}{2} \div (\tfrac{11}{12} + \tfrac{1}{15}\text{ of }\tfrac{1}{12}) : 46 \div \tfrac{23}{24}$$

$$:: 88\tfrac{1}{2} \div (\tfrac{11}{12} + \tfrac{1}{180}) : \frac{2}{46} \times \frac{24}{23}$$

$$:: 88\tfrac{1}{2} \div \tfrac{177}{180} : 48$$

$$:: \frac{177}{2} \times \frac{180}{177} : 48$$

$$:: 96 : 48$$

$$:: 2 : 1$$

∴ A gold coin of 2nd nation = 2 gold coins of 1st nation.

6. W. T.—Find the increase in annual income produced by transferring the sum of £4,500 from consols at $98\frac{7}{16}$, to the $4\frac{1}{2}$ per cents. at $96\frac{1}{4}$.

Note.—Consols are at 3 per cent., unless otherwise stated.

Income in 1st case = £(45 × 3)
= £135

£ £
$96\frac{1}{4}$: $98\frac{7}{16}$ } :: £4,500 : Income in 2nd case
£ £
100 : $4\frac{1}{2}$
1,540 : 1,575 } :: £4,500 : "
200 : 9

$$\text{Income in 2nd case} = \frac{1{,}575 \times 9 \times 4{,}500}{1{,}540 \times 200}\,£$$

= £207 2s. $0\frac{3}{11}$d. $\frac{3}{11}$ q.

∴ Increase in income = £207 2s. $0\frac{3}{11}$d. $\frac{3}{11}$ q.—£135
= £72 2s. $0\frac{3}{11}$d. $\frac{3}{11}$ q.

7. M. A. SMITH, Chepstow.—What sum will amount to £425 19s. 4½d. in 10 years at 3½ per cent. simple interest, and in how many years will it amount to £453 11s. 7d.?—*Barnard Smith.*

£3½ × 10 = £35.

£ £ s. d. £
∴ 35 : 425 19 $4\frac{1}{2}$ :: 100 : Principal
27 20 20
278,519 8 0
£315 10 8 Ans.

£ s. d.		£ s. d.	
425 19 4½		453 11 7	
315 10 8		425 19 4½	
110 8 8½	:	27 12 2½	:: 10 yrs. : Time
20		20	
2,208		552	
12		12	
26,504		6,626	
5		5	
132,524		33,131	

132,524)331,310(2½ yrs. Ans.
265,048
66,262

8. LLOYD.—A sum of £3,750 was sold out of the 3 per cents. at 95, and put at compound interest for 2 years at 4 per cent.; the amount being laid out in the 3½ per cents. at 104, find alteration in income.

(To be worked by Rule of Unity).

Income in 1st case = $(37\frac{1}{2} \times 3)$£
= £112½.

Amount realized by sale of this stock = $(37\frac{1}{2} \times 95)$£
= £3562½.

£
4% = 3562·5
4% = 142·5
3705·0
4% = 148·2
3853·2

Income on £1 in 2nd case = $\frac{3\frac{1}{2}}{104}$£.

∴ " in 2nd case = $\frac{3853{\cdot}2 \times 3\frac{1}{2}}{104}$£

$$= \frac{1926{\cdot}6 \times 7}{104}\,£.$$

$$= \frac{13486{\cdot}2}{104}\,£.$$

= £129 13s. 6d.

∴ Alteration in income = £129 13s. 6d. − £112½
= £17 3s. 6d.

Algebra.

1. G. LAMOTTE, Teynham.—Solve the equations—

$$\left.\begin{aligned} &(1)\quad x^2 = \frac{39}{y} - \frac{14}{x} \\ &(2)\quad y^2 = \frac{42}{x} - \frac{13}{y} \end{aligned}\right\}$$

Multiplying (1) by 3:—

$$\left.\begin{aligned} 3x^2 &= \frac{117}{y} - \frac{42}{x} \\ (2)\quad y^2 &= \frac{42}{x} - \frac{13}{y} \end{aligned}\right\}$$

Adding:— $3x^2 + y^2 = \frac{104}{y}$

∴ $3x^2y + y^3 = 104$ (3).

Multiplying (2) by 3:—

$$\left.\begin{aligned} 3y^2 &= \frac{126}{x} - \frac{39}{y} \\ (1)\quad x^2 &= \frac{39}{y} - \frac{14}{x} \end{aligned}\right\}$$

Adding:— $x^2 + 3y^2 = \frac{112}{x}$

∴ $x^3 + 3xy^2 = 112$ (4).

Adding (3) and (4) :— $x^3 + 3x^2y + 3xy^2 + y^3 = 216$
Subtracting (3) from (4) :— $x^3 - 3x^2y + 3xy^2 - y^3 = 8$

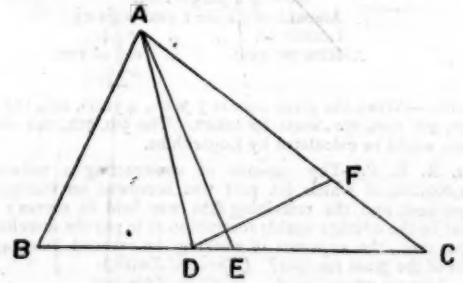
Extracting cube roots—

$$\left.\begin{aligned} x + y &= 6 \\ x - y &= 2 \end{aligned}\right\}$$

∴ $x = 4$ and $y = 2$.

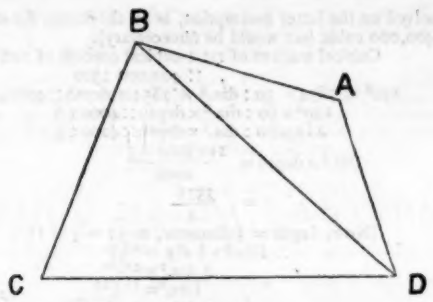
Geometry.

1. A SUBSCRIBER, Nottingham.—ABC is any triangle. AD bisects the angle A, and AE is drawn to E, the middle point of BC; prove that AE > AD.



Let AC be greater than AB.
Make AF = AB, and join DF.
Proof.—FA, AD = BA, AD, each to each, and ∠ FAD = ∠ BAD (Hyp.)
∴ FD = BD (I. 4), and ∠ ADF = ∠ ADB.
∠ ADB is greater than ∠ AED (I. 16)
∴ ∠ ADF " " "
Much more then is the ∠ ADE greater than the ∠ AED.
∴ AE is greater than AD (I. 19).

2. N. E. SANDERSON, Sheffield.—Given the four sides of a quadrilateral figure in order, and the angle between one pair of opposite sides, construct the figure. (*Science and Art*, 1881.)



The sides BA, AD, and the angle BAD being known, the triangle BAD can be constructed.

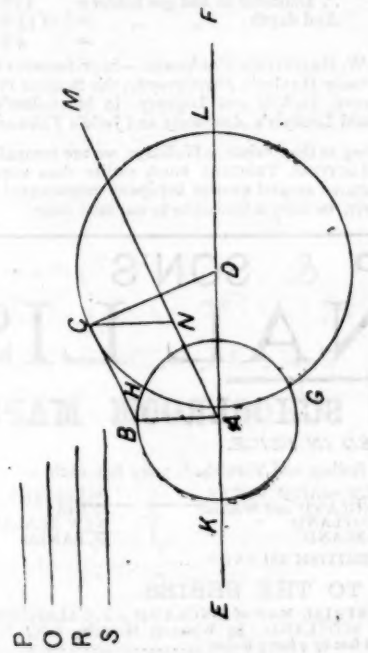
In the triangle BDC, the three sides are known, and therefore it can be constructed.

Thus the quadrilateral figure can be constructed.

The length of the sides BA, AD, and the angle A being given, BD can be found by Trigonometry.

E. CROSS, Faversham.

The above solution was forwarded by the correspondent whose name it bears, but it is *incorrect*, as the given angle is situated between two *opposite* not *adjacent* sides. The correct solution is herewith appended.—Query Editor.



Construction.—Take any straight line EF. Made AD = S. From A with radius P describe circle GHK; and from D with radius = R describe circle GHL. At A make the angle DAM equal given angle. From AM cut of AN = Q; and from N with radius = P describe a circle cutting circle GHL in C. Draw AB parallel to CN, and cutting circle GHK in B. Join CB and CD.

Then ABCD shall be the required quadrilateral.

Proof.—The side AD=S (Con.), and the sides AB, CD = P, R, respectively (Def. 15); Also BC = AN (I. 33) = Q (Con.). Therefore, the quadrilateral ABCD has its sides equal to P, Q, R, S, respectively. Because BC is parallel to AN (I. 33) the angle formed by BC, AD = ∠DAM (I. 29) = given angle. (Con.).—Q. E. F.

General.

1. X. Y.—Consult the nearest bookseller.

2. A CONSTANT READER.—Articles of special interest to Female Teachers will appear in the new volume.

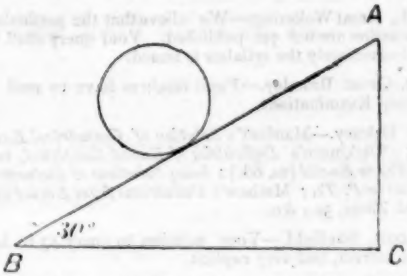
Dr. Smith's series of French and German books are excellent.

3. D. A., Nottingham.—Curtis's History, 5s. 6d.

4. SPHINX, Cornwall.—A sphere of wood, loaded at one end with lead, rests upon a plane inclined at 30° to the horizon, being prevented from sliding down by the friction of the plane.

State and explain by a diagram the condition of equilibrium. (From Matric. Paper).

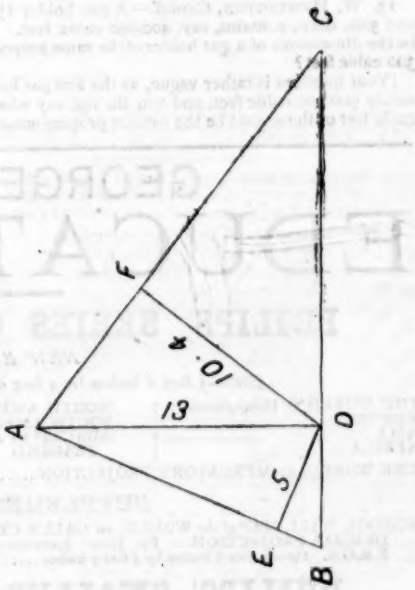
This question is bookwork.



Coefficient of fraction.
= tan ABC
= tan 30°
$= \frac{1}{\sqrt{3}}$.

The other will be attended to next month.

5. B. B. S.—ABC is a triangle, and AD is the perpendicular from A on BC. If AD = 13 feet, and the lengths of the perpendiculars from D on AB and AC be 5 feet and 10·4 feet respectively, find the sides and the area of the triangle.—Todhunter's *Mensuration for Beginners*.



$AE = \sqrt{13^2 - 5^2}$ (I. 47) $= \sqrt{144} = 12$ft.

The △ ADB is right-angled.

$\therefore AE \times EB = DE^2$ (See Euclid II. 14).

$\therefore EB = DE^2 \div AE$

$= 5^2 \div 12$

$= 2\frac{1}{12}$ft.

$AB = AE + EB = 14\frac{1}{12}$ft.

$$AF = \sqrt{13^2 - (10\tfrac{2}{5})^2} = \sqrt{169 - 10\tfrac{24}{25}} = \sqrt{\frac{4225 - 2704}{25}}$$

$$= \sqrt{1\tfrac{521}{25}} = 1\tfrac{21}{25}\text{ft.}$$

$AF \times FC = DF^2$

$\therefore FC = DF^2 \div AF$

$$= (5)^2 \div \tfrac{21}{5} = \frac{25}{1} \times \frac{5}{21} = \frac{125}{21}\text{ft.} = 5\tfrac{20}{21}\text{ft.}$$

$AC = AF + FC = \frac{5^2}{8} + \frac{300}{16} = \frac{325}{16} = \frac{85}{4} = 21\frac{1}{4}$ft.

$BD = \sqrt{(2\frac{1}{2})^2 + 5^2} = \sqrt{\frac{225}{16} + 25} = \sqrt{\frac{625}{16}} = \frac{25}{4}$ft.

$DC = \sqrt{AC^2 - AD^2} = \sqrt{(\frac{85}{4})^2 - 13^2} = \sqrt{\frac{7225}{16} - 169}$

$= \sqrt{\frac{4521}{16}} = \frac{67\frac{1}{2}}{4}$ft.

$BC = BD + DC = \frac{25}{4} + \frac{67\frac{1}{2}}{4} = \frac{92\frac{1}{2}}{4} = 22\frac{1}{4}$ft.

Area of $\triangle ABC = \frac{BC \times AD}{2} = \frac{22\frac{1}{4} \times 13}{2}$

$= \frac{91 \times 13}{8} = \frac{1183}{8} = 147\frac{7}{8}$ sq. ft.

6. C. C. J., Great Wakering.—We believe that the particulars of the examination are not yet published. Your query shall be attended to immediately the syllabus is issued.

7. STUDY, Great Bromley.—Pupil teachers have to read at the Scholarship Examinations.

8. J. H., Orkney.—Manford's *Solution of Geometrical Exercises*, 2s. 6d.; Dickinson's *Difficulties of Euclid Simplified*, 1s.; Wollman's *Key to Euclid* (2s. 6d.): *being Solutions to Deductions and Riders Set to P. Ts.*; Mathew's *Deductions from Euclid and How to Work Them*, 3s.; &c.

9. G. BACON, Sheffield.—Your solution to query 43 in last issue is quite correct, and very explicit.

10. ALPHA, Dumfries.—*Chemistry*, Fowne's, 7s. 6d.; Roscoe's, 4s. 6d.

Agriculture.—Stewart's Agriculture; Gill's Agriculture.

11. SUBSCRIBER, Wandsworth.—We are sorry we are unable to give you the information you desire.

12. A. O. E., Carnarvon.—Your solutions to query 42 in last issue are *incorrect*. See correct solution in this number.

13. W. HEMINGTON, Cardiff.—A gas holder 150ft. diameter and 30ft. deep, contains, say, 400,000 cubic feet. What should be the dimensions of a gas holder of the same proportions to hold 300 cubic feet?

(Your question is rather vague, as the first gas holder will hold nearly 900,000 cubic feet, and you do not say whether the 300 cubic feet of the second be the total or proportionate capacity. It is solved on the latter assumption, as on the former the statement of 400,000 cubic feet would be unnecessary).

Cubical content of 1st : cubical content of 2nd

:: 400,000 : 300

$150^2 \times .7854 \times 50 : \text{dia.}^2 \times .7854 \times \text{depth} :: 4000 : 3$

$150^2 \times 50 : \text{dia.}^2 \times \text{depth} :: 4000 : 3$

$1125000 : \text{dia.}^2 \times \text{depth} :: 4000 : 3$

$\text{Dia.}^2 \times \text{depth} = \frac{1125000 \times 3}{4000}$

$= \frac{3375}{4}$

(Now, depth $= \frac{1}{5}$ diameter, as $50 = \frac{1}{5}$ of 150)

$\therefore \text{Dia.}^2 \times \frac{1}{5}\text{ dia.} = \frac{3375}{4}$

$\frac{1}{5}\text{ dia.}^3 = \frac{3375}{4}$

$\text{Dia.}^3 = \frac{16875}{4}$

$\therefore \text{Dia.} = \sqrt[3]{\frac{16875}{4}}$

$\text{Dia.} = \frac{\sqrt[3]{20250}}{2} = \frac{27\cdot2\ldots}{2} = 13\cdot6\ldots$

20250(27·2…

8

12250

$2^2 \times 300 = 1200$

$2 \times 7 \times 30 = 420$

$7^2 = 49$

1669 | 11683

$27^2 \times 300 = 218700$

$27 \times 2 \times 30 = 1620$

$2^3 = 4$

220324 | 440648

126352

$\therefore$ Diameter of 2nd gas holder = 13·6…ft.

And depth " " $= \frac{1}{5}$ of 13·6…ft. = 4·5…ft.

14. W. GRIFFITHS, Slaithwaite.—In preference to the book you name study Huxley's *Physiography*, the Science Primers written by Grove, Geikie, and Lockyer, in Macmillan's Series. To these add Lockyer's *Astronomy* and Judd's *Volcanoes*.

Owing to the Christmas Holidays, we are compelled to publish the PRACTICAL TEACHER much earlier than usual. This has necessitated several queries being left unanswered. They will, however, be fully attended to in our next issue.

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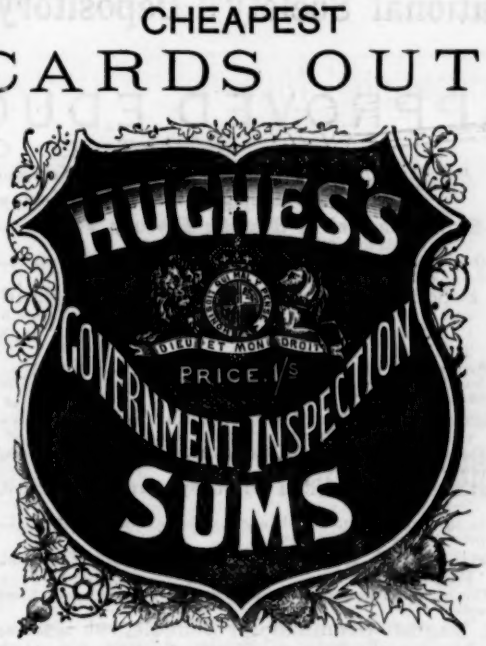

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